

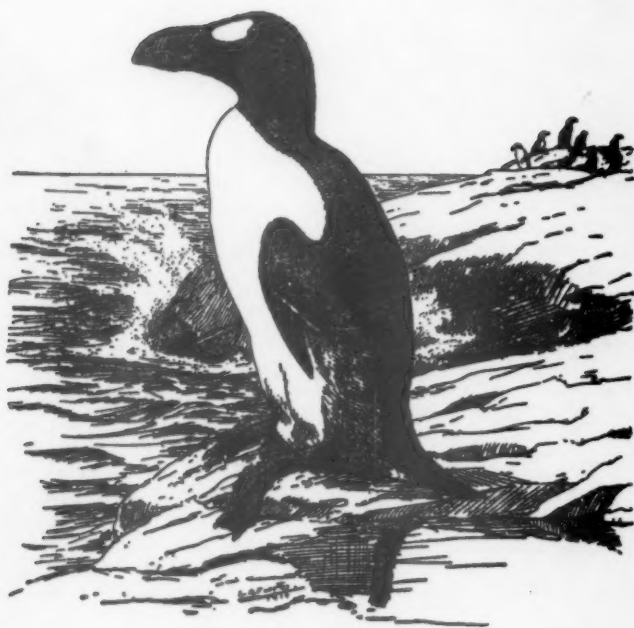
# The Auk

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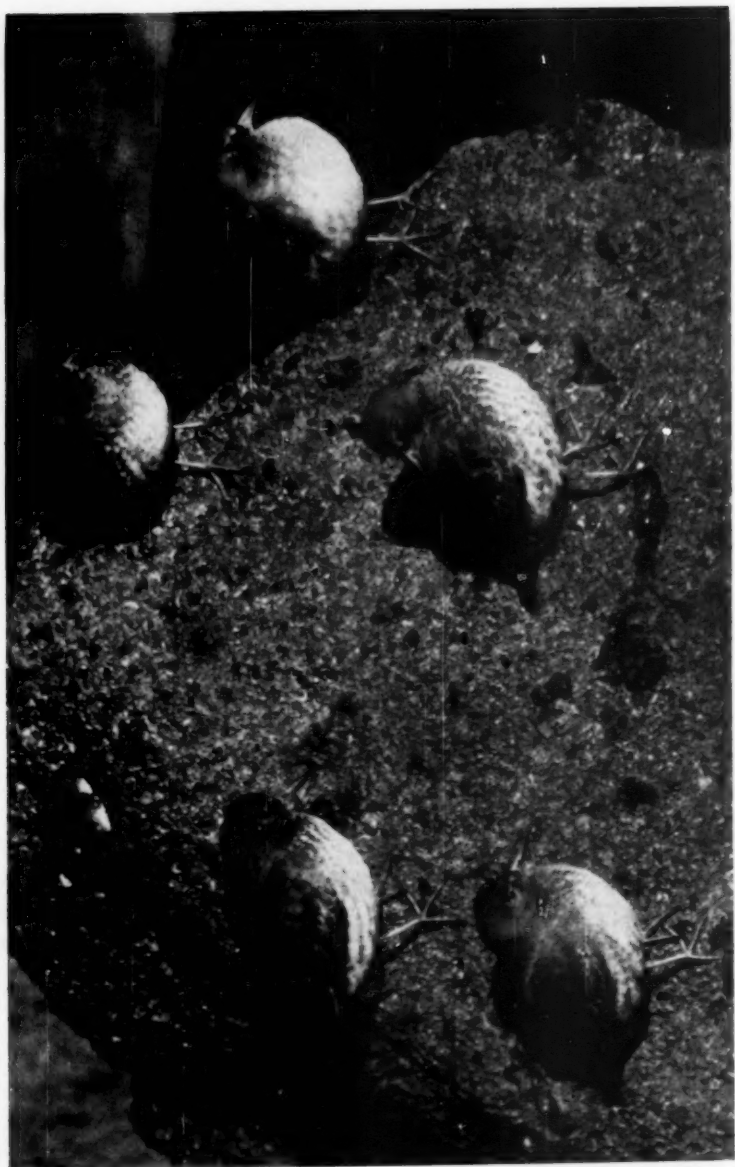
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# THE AUK

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## BIRDS OF AMCHITKA ISLAND, ALASKA

KARL W. KENYON

AMCHITKA Island, in the Rat Island group of the Aleutian Islands, is volcanic in origin and rises near the southernmost limit of the Aleutian Ridge. It is situated between  $178^{\circ}37'E.$  and  $179^{\circ}29'E.$  longitude and  $51^{\circ}21'N.$  and  $51^{\circ}39'N.$  latitude (Figure 1). Its length is approximately 55 kilometers (35 miles) and its width 5 to 8 kilometers (3 to 5 miles). It lies approximately 1,200 kilometers (660 nautical miles) southwest of the tip of the Alaska Peninsula and about the same distance southeast of Cape Kamchatka on the Kamchatka Peninsula. The island is part of the Aleutian National Wildlife Refuge.

The maritime climate of Amchitka is relatively uniform and is characterized by fog in summer and clear weather interspersed with frequent storms in winter. The island lies in the path of storms that move eastward from Siberia. The temperature extremes recorded during the study period were  $-6^{\circ}C$  ( $+21^{\circ}F$ ) in February and  $+18^{\circ}C$  ( $+64^{\circ}F$ ) in July. Powers, Coats, and Nelson (1960) give the following general weather data obtained from The Arctic Weather Central, 1950, which was taken at the Amchitka air base between 1943 and 1948: the mean annual temperature was  $+4.4^{\circ}C$  ( $+40^{\circ}F$ ), winds in summer averaged 32 kilometers (20 miles) per hour and seldom exceeded 110 kilometers (70 miles) per hour. In winter, winds averaged 40 kilometers (25 miles) per hour and frequently exceeded 160 kilometers (100 miles) per hour. Precipitation, including 178 cm. (70 inches) of snowfall, averaged 89 cm. (35 inches).

**Rock Sandpipers wintered in the shelter of Kirilof Dock, Amchitka Island. At high tide the birds rested, during low tide they foraged on exposed tidal rocks. 26 January 1959. KWK 59-1-10.**



Amchitka is treeless. Flora of the subarctic or tundra association cover all suitable areas. The terrain is generally flat or rolling on the eastern half of the island, ranging in altitude from about 45 to 165 meters. The western half is mountainous, rising to an altitude of 420 meters. During World War II, Amchitka was an important air base. As many as 10,000 men are said to have been stationed there. There are three large air strips near the eastern end of the island and a number of miles of surfaced taxi ways to serve them. Roads of crushed rock lead to many parts of the eastern half of the island. Hundreds of telephone poles, rotting Quonset huts, and other buildings scattered over the landscape serve as constant reminders of wartime occupation. During the 1955-1959 periods of our studies, the island, except for our presence, was unoccupied.

Observations of birds in winter for the Aleutian area are few. They have been published for the Unalaska area (Cahn, 1947), Adak (Taber, 1946), and Attu (Sutton and Wilson, 1946). Brief visits to Amchitka have been made by a number of zoologists, usually during the summer season. Available ornithological information for the Aleutian area has been summarized by Murie (1959) and Gabrielson and Lincoln (1959).

The data presented in this paper include observations and specimen records from all seasons and were obtained during four periods that I spent on Amchitka: 27 July to 4 October 1955; 5 May to 26 July 1956; 1 October to 11 December 1957; and 21 January to 20 May 1959. As much as possible, I have attempted to eliminate data that duplicate material already in published form. While sea otter (*Enhydra lutris*) studies were the primary objective of the visits to Amchitka, observations of birds were recorded when time permitted, and an effort was made to collect all unusual species seen. Time did not permit a search for all nesting species.

Predators have had an important effect on certain resident bird populations of Amchitka. The blue fox (*Alopex lagopus*) was introduced there in historical times, but the date of its introduction does not seem to be recorded. The World War II military occupation ended in 1951, leaving behind dogs, cats, and the house rat (*Rattus norvegicus*). A program of predator eradication was immediately begun. In 1951, 180 kilograms (400 pounds) of 1080-treated baits were distributed on the east end of the island. This eradication program eliminated the dogs and cats, and reduced foxes and rats in local areas. In an attempt to eliminate foxes completely, poisoning was continued: 1953-1954, 5,000 strychnine pellets were distributed by air drop over

the western half of the island; 1955, strychnine pellets were distributed by hand over the eastern half of the island; 1956, 40,000 strychnine pellets and 90 kilograms (200 pounds) of fish containing 1080 poison were distributed over the island by air drop; 1957, about 40,000 strychnine pellets were distributed by air drop (R. D. Jones, *in litt.*). In 1959, when snow covered the ground, I searched many miles for fox tracks and saw signs of only one fox on the eastern half of the island. Efforts to eliminate any remaining foxes were intensive in the summer of 1960, but at least one animal could not be hunted down (Jones, *in litt.*).

The extent to which the blue fox has affected bird populations is a moot question. The small passerines were apparently not threatened by them. The Common Teal (*Anas crecca nimia*) and the Mallard (*Anas platyrhynchos*) maintain nesting populations on Amchitka and other islands inhabited for many years by foxes. The Aleutian race of the Canada Goose (*Branta canadensis leucopareia*), however, is now all but extinct. Whether or not the fox is responsible for its reduction is an unanswered question (Murie, 1959).

The house rat is today extremely abundant on Amchitka Island. Neighboring Rat Island was apparently infested prior to 1790, when it received its name. Amchitka, however, was free of rats until World War II military occupation (Murie, 1959). Since then the population has prospered. Even today, nearly 10 years after the departure of the military, great colonies of rats persist in abandoned garbage dumps. From these centers of abundance they have spread to all parts of the island. They are most numerous near shorelines, where food and cover are readily available. Inland, food and cover are sparse and rats are scarce, but I have seen occasional diggings in the tundra at maximum distances from the coast. The degree to which nesting bird populations have been affected by rat predation varies with different species. Near the beach at the head of Constantine Harbor I have watched broods of Common Teal melt away in the course of a few days after hatching and found rat-gnawed remains of ducklings at pond edges. This teal is, nevertheless, the most abundant resident duck at Amchitka. The fact that it nests on inland lakes where rats are not abundant may account for its ability to survive in spite of them. Jones has found rats on all islets adjacent to Amchitka. In spite of their presence on the Kirilof Islets, numbers of the Common Eider (*Somateria mollissima*), Glaucous-winged Gull (*Larus glaucescens*), and Tufted Puffin (*Lunda cirrhata*) annually raise broods there. It appears, however, that the rat has exterminated two nesting species on Amchitka.

the Song Sparrow (*Melospiza melodia maxima*) and the Winter Wren (*Troglodytes troglodytes kiskensis*).

Murie (*in litt.*) found rats common but confined to the beaches on Rat Island, and he notes further that "In my field notes I find no records of song sparrows or wrens [there]." On Atka Island, however, he found rats as well as the Song Sparrow and Winter Wren. But he noted "that on Rat Island these rodents are confined to the beach, while on Atka there is plenty of inland vegetation" and the rats were not concentrated along beaches but more generally distributed inland. The available information indicates that where food and cover for rats are scarce inland the rats concentrate their populations along the shore, which is the habitat of the Winter Wren and Song Sparrow, and these two species may then be in danger of extermination. Rats also became established on Adak, Kiska, and other islands, where they were introduced by the military during World War II (Jones, *in litt.*). Wrens and Song Sparrows are still abundant on Adak. It appears that ecological conditions there may be similar to those on Atka. Rats have escaped on the Pribilofs many times but have never become established there. When the rat becomes established in the favorable habitats that the Aleutians appear to offer, eradication is probably impossible by any known means.

From the ornithological point of view, Amchitka differs from many Aleutian islands. Its population of alcids is small, while the Fulmar (*Fulmarus glacialis*) and Black-legged Kittiwake (*Rissa tridactyla*) are apparently absent from the breeding bird population.

The observations presented are from the eastern half of Amchitka. The western mountainous section is difficult of access, and our work did not take us there.

Sixty-nine species are included in the following annotated list. Among the specimens and observations obtained at Amchitka are two species (*Turdus obscurus* and *Muscicapa griseisticta*) and two races (*Phylloscopus borealis examinandus* and *Motacilla flava similima*) new to the North American list; these specimens are listed by Gabrielson and Lincoln (1959). Five additional species are represented on the North American list by very few records, and four others found on the North American mainland have not previously been collected in the Aleutians. In addition, there are a number of species listed that have not previously been recorded specifically from Amchitka. Some of these are of quite general distribution in the Aleutians and would therefore be expected at Amchitka. Others, however, have rarely been recorded in the Aleutian area. Species of Asian origin were usually found, as would be expected, during the spring and fall migration periods following storms.

#### ANNOTATED LIST

*Gavia immer*. Common Loon. During spring and fall I have seen, at a distance, loons presumed to be this species. On 10 August 1955 about 10 were

seen on Constantine Harbor and in flight over the water, many of them uttering loud calls. In June 1956 a pair, presumably nesting, was seen on a lake near the east end of the island.

*Gavia stellata*. Red-throated Loon. 16 July 1956 two young, about 10 days old, were seen on a small tundra pond near the middle of the island, and Jones (*in litt.*) saw young on several lakes in the summer of 1960. Pairs, presumed to be breeding, were seen each spring on several lakes on the eastern half of the island. Although said to winter in the Aleutians, they were apparently absent at Amchitka during the winter months.

*Diomedea albatrus*. Short-tailed Albatross. No living birds have been seen. In Kitchen Middens, several of which are being washed away by tsunami and storm waves, the bones of several avian species are numerous. This species, bones of which were identified at the U.S. National Museum, predominates. Its remains are recorded from middens on other Aleutian Islands (Murie, 1959).

*Diomedea immutabilis*. Laysan Albatross. In addition to the beach remains of two individuals previously recorded (Kenyon, 1950), a dead bird was found on the beach of St. Makarius Point on 17 June 1956. During an aerial survey on 26 May 1959, a lone Laysan Albatross was seen in flight at 179°58'W. and 51°58'N., approximately 65 kilometers (40 miles) northeast of East Cape, Amchitka. On a dory trip from Amchitka to Semisopochnoi on 24-26 June 1960, Jones (*in litt.*) saw two Laysan Albatrosses; on 14 July he saw another about five kilometers (three miles) south of Windy Island, off the Pacific shore of Amchitka.

*Phalacrocorax pelagicus*. Pelagic Cormorant. This appears to be the most numerous and well-adapted resident marine bird at Amchitka. During violent winter storms, with winds of 110 kilometers per hour and more, when other birds seek shelter, this cormorant frequents its usual inshore feeding areas. It nests principally on islets. On the Kirilof Islets a pair was noted sitting on a newly made nest on 23 April 1959, but nest building appeared to be at its height in mid-May when many birds were seen gathering bills full of grass from the steep slopes of Kirilof Point. Three nests contained one, three, and four eggs on 23 May 1956; birds were incubating on a number of others. On 8 July several nests still contained eggs, and others contained young about a week old. The white flank patches of breeding plumage appear during February. Among about 50 birds seen on 5 February 1959, only one showed white patches. Among about 100 birds seen on 26 February, the majority showed them. Cormorants frequently became entangled in gill nets set at depths of 6 to 15 meters but were seldom taken at depths of 23 to 26 meters in Constantine Harbor. On several occasions I saw a bird surface with a fish in its bill. On 1 August 1955 a Glaucous-winged Gull snatched a fish from a cormorant, which retaliated by grasping the gull's tail feathers. It was towed several yards before releasing its hold. Murie (1959) states that natives of Atka Village told him that this cormorant "will go to the lakes of Amchitka Island in winter." I have seen it only on the sea, never on a lake.

*Olor cygnus*. Whooper Swan. This species was seen regularly but in small numbers from fall through early spring at Amchitka. Nevzeroff, who spent the winters of 1940 and 1946 on Amchitka trapping foxes, said that he saw several flocks of four to six swans in both seasons and always on Silver Salmon Lake. However, he did not identify them as to species. Murie (1959) obtained native reports of many swans, presumed to be Whistling Swans (*Olor columbianus*), on

Amchitka in the winter months. All swans listed below were examined through a 50-power telescope and were positively identified as *cygnus*. I have seen no other species on Amchitka.

On 26 October 1957 two adults were seen on the lake at the head of St. Makarius Bay. The following day probably the same pair was on Silver Salmon Lake. On 8 November 1957 seven birds, four adults and three subadults in gray plumage, were feeding on Silver Salmon Lake. On 9 November 1957 I collected an adult male (USNM 465720) from this group. It had much body fat and weighed 12.7 kilograms. Its length was 1,437 mm., and the wing span was 2,285 mm. The stomach was filled with finely ground aquatic vegetation. On 9 December 1957 one adult was on the lake at the head of Constantine Harbor. On 15 March 1959 six birds, two adults and four subadults in gray plumage, were on Silver Salmon Lake. On 18 March 1959 the six (recorded above) plus two adults and one subadult were seen. The two groups remained separate but loosely associated on Silver Salmon Lake and when frightened flew to a nearby lake. On 29 March 1959 a lone adult was on Silver Salmon Lake. On 2 April 1959 a flock of nine, six adults and three subadults, rested and fed on Silver Salmon Lake. In summary, during fall months of 1957, seven adult and three subadult swans were seen, and one was collected. During late winter and early spring of 1959 11 adults and 8 subadults were seen. The swans showed a preference for Silver Salmon Lake. The available data indicate that *cygnus* probably visits Amchitka regularly during migration to and from Siberian nesting grounds. The Whooper Swan was added to the North American list when Wilke collected a specimen on St. Paul Island (Wilke, 1944). I found this specimen, which was misplaced during the war, buried among Government files on St. Paul Island. It is now USNM 419832. A second specimen (USNM 397550) was killed and given to me by Anton Kochutin on St. Paul in 1949. The specimen reported from Amchitka is the third specimen record for North America.

*Branta canadensis leucopareia*. Canada Goose. The decline in abundance of this bird in the Aleutians is reviewed by Murie (1959). Jones (*in litt.*) says that in the early 1950's he saw a pair on one of the lakes at Amchitka, but during a search for nesting waterfowl in the summer of 1960 he found none. I have seen it only once. On 9 May 1959 a flock of seven birds landed on one of the Kirilof Islets and fed on an open grassy area that day and the next. On 10 May I collected a female (USNM 466346), which weighed 1,927 grams. The ovaries had not approached breeding condition. This was apparently a very old bird, being extremely fibrous and tough. The remaining six birds flew westward along the shore and did not return to the Constantine Harbor area. Krog (1953) collected one at this same location on 10 June 1952. During spring and summer months I have walked over many miles of Amchitka's lowland country, skirting the scattered lakes. On 19 and 20 May 1959, during an aerial survey of sea otters, we passed over the majority of Amchitka's lakes and looked for geese without success. There can be little doubt that, as a nesting species, this goose is extinct on Amchitka. On 20 May 1959 Refuge Supervisor David L. Spencer and I made a special effort to inspect every lake on Agattu Island from low altitude flight. The only bird we saw was a Common Loon. All available evidence indicates that today the Aleutian nesting goose population is nearly extinct.

*Phalacrocorax auritus*. Emperor Goose. This species winters in numbers at Amchitka. On 19 November 1957 a low-altitude aerial survey around Amchitka revealed numerous flocks along the beachline, except on the southwestern quarter



of the island where the terrain falls abruptly into the Pacific. An estimate of 500 to 700 birds was made. In the fall the first small flock of six birds was seen on 16 October. During January and February several hundred geese, in flocks of 30 to 50 birds, occupied beaches of bays or rocks along points having areas of kelp exposed at low tide. By early March the number of geese present became about half that of the midwinter period. The number present continued to decrease steadily throughout March and April. The last flock was seen on 21 April. Although this goose may walk to fresh-water puddles and small ponds beside the beach, or gather at the mouths of streams on the beach to bathe and preen, Jones and I have not seen it on lakes at Amchitka, but Jones (*in litt.*) has observed it in the fall on lakes near Cold Bay, Alaska. It habitually feeds among rocks and kelp beds at low tide, but after storms, flocks gather to feed among heaps of kelp that have washed ashore.

On 3 and 4 March 1960 an aerial survey was made in the eastern Aleutians. Dale W. Rice and I recorded our estimates of the number of Emperor Geese in each flock seen. The data obtained are summarized below:

Islands of Four Mountains	1,020
Fox Islands	
Umnak Area	2,375
Unalaska	7,375
Krenitzin Islands	1,400
Unimak-Amak	200
Sanak and Sandman Reefs	100
	<hr/> 12,470

Considering that, at this period, many of the geese wintering in the Aleutians have moved eastward, our count perhaps represents between one half and one third of the wintering population of the Aleutian Islands, which I estimate at 25,000 to 37,000. Spencer and Jones (*in litt.*) suggest that important numbers of Emperor Geese may winter along the Alaska Peninsula and that the total Emperor Goose population may be on the order of 200,000 birds. Natives of Atka and Nikolski told me that they kill a few each winter, but that the birds quickly become wild where they are hunted and for this reason the number taken is not large.

*Anas platyrhynchos*. Mallard. Among the waterfowl this species is second in abundance only to *Anas crecca nimia*. In late January several large flocks, one of about 200 birds, were seen at Rifle Range Point. Generally, however, flocks consisted of 5 to 15 birds. In early March, when all fresh water was frozen over, Mallards fed among pools and kelp exposed at low tide. Even at other times they habitually fed to some degree in the tidal zone. Pair formation takes place in mid-March. By 9 May mated pairs occupied small ponds and marshy areas. By 10 June females were seldom seen, indicating that incubation was in progress. On eight occasions, between 11 and 29 June 1956, an adult female was flushed from a small pond by the passage of our truck on a surfaced road. This bird left the pond to approach the truck route when we were at a distance of about 200 meters. She flew low and rapidly, crossed the road in front of the truck, then turned to fly parallel to it, increased her speed to stay about 10 meters ahead of and on the right-hand side of the truck; a position she held for approximately 1-2.5 kilometers. She then turned left in a high arc over a hill, and returned to



her starting place. According to the speedometer her top speed was 92-96 kilometers (58 to 60 miles) per hour, while about 60 meters of altitude was gained along the sloping, up-hill road. Her flight pattern during this decoy or distraction behavior was the same on each occasion. In early October the Mallard was less abundant than at other seasons. By mid-October the number present increased, perhaps indicating some interisland migration.

*Anas acuta*. Pintail. This species occurs regularly in the spring but not in great numbers: 1 March, one at head of Constantine Harbor; 22 and 28 March, one pair on lake near Constantine Harbor; 4 April, four seen; 7 April, five seen; 15 April, flock of 50; last two weeks of April, flocks seen on numerous occasions; 3 May, one pair, St. Makarius Point. Jones (*in litt.*) saw a brood of five on 15 July 1952 near Kirilof Bay, and several more in the summer of 1960.

*Anas crecca nimia*. Common Teal. This species is abundant throughout the year. On the eastern half of Amchitka the late summer population is roughly estimated to be at least 1,000 birds. During winter months flocks of 25 to more than 100 occupy favorite ponds or beaches during high tide. At low tide the birds feed in shallow water among exposed reefs. In the spring and summer they feed among the vegetation of shallow fresh-water ponds and lakes and to a lesser degree in salt water. Pair formation takes place in March, and by 9 May the pairs are scattered widely among the small ponds and lakes. The nesting period is prolonged. A nest with six partially incubated eggs was seen 8 June; on 12 June a newly hatched brood was seen, and on 17 June two nests, containing six and nine fresh eggs, were found. On 31 July a brood of six newly hatched young and broods of two and three young each, about half grown, were seen. Nests are placed near stream edges and in grass clumps, often several hundred meters from the nearest water. By late August the flocks have formed, mostly on lakes near shorelines. During October the number seen at usual resting and feeding places decreases, perhaps indicating a degree of migration. Many, however, remain throughout the winter. Predation by the blue fox has been unimportant during the past few years because of the fox-reduction program. The present teal population seems not to have been damaged by the many years of high fox population of the 1930's and 1940's. Today the excessive number of rats along shore areas may act to limit the teal population there. Seldom do more than one or two young from broods hatched near beach areas reach flight age. The Bald Eagle and Peregrine Falcon often harass teal. However, on the many occasions I have watched these raptors, especially the falcon, stoop on teal, I have never seen one caught. The teal, when flying, remain in flocks near the water; as a falcon approaches, all immediately flop into the water where the falcons do not attack them. Eagles are easily avoided by making sharp turns.

*Anas carolinensis*. Green-winged Teal. On 15 March a male (USNM 466828) weighing 283.5 grams was taken on a small shallow lake at the head of Constantine Harbor. It was near but not with a flock of about 60 Common Teal. As Murie (1959) points out, this species is quite abundant in the Alaska Peninsula area, only stray individuals moving westward into the Aleutians. It has not previously been recorded from Amchitka.

*Mareca penelope*. European Widgeon. On 30 April a flock of 11 (7 males, 4 females) was closely observed through 7 x 50 binoculars on the lake near the head of Constantine Harbor. They were joined by another pair on 2 May. The original flock of 11 birds was observed repeatedly on several lakes until 10 May,

when they apparently departed. Jones (*in litt.*) says that he saw this species twice on Amchitka in 1949, again in 1960, and has checked one in a hunter's bag at Cold Bay on the Alaska Peninsula. The species has not previously been recorded from Amchitka, but other records indicate that it may be expected in the Aleutians in spring (Murie, 1959).

*Spatula clypeata*. Shoveler. On 7 April Jones and I saw a flock of five at close range at Rifle Range Point. Jones (*in litt.*) has observed Shovelers at Amchitka several times, but the species has not previously been recorded from the Aleutians.

*Aythya marila*. Greater Scaup. Between 29 January and mid-April flocks of 10 to 20 birds visited several of the deeper fresh-water lakes, particularly Jones Lake, on the east half of Amchitka. Individual flocks apparently visited the island for a week or two, then left. This species has frequently been recorded throughout the Aleutians during spring and summer months. Jones (*in litt.*) found it nesting on Amchitka in 1960 and "banded a few nestlings."

*Bucephala clangula*. Common Goldeneye. This species winters in moderate numbers. Flocks of 6 to 15 birds, sometimes mixed and at other times of one sex, frequented Constantine Harbor and nearby lakes. Other flocks were seen at South Bight (40 birds on 1 March 1959) and at several places along the Pacific and Bering Sea shores. My last observation is for 29 March. Although recorded at other places in the Aleutians, it has not previously been specifically recorded from Amchitka.

*Bucephala albeola*. Bufflehead. In summarizing the data on this species, Murie (1959) indicates that it is of rather sparse and irregular distribution in the Aleutians in winter. From January to late April a number remained at Amchitka. The following were noted: 27 January, two flocks: 12 birds (4 males and 8 females) and 29 birds (10 males and 19 females); 19 February, 29 birds (8 males and 21 females) all near the head of St. Makarius Bay. In addition, pairs and small flocks were regularly seen on inland lakes, especially on Jones Lake. The species should, therefore, be considered a rather common wintering bird at Amchitka.

*Clangula hyemalis*. Oldsquaw. Flocks of six to as many as 150 birds were seen frequently in Constantine Harbor and along the Pacific side of the island, February through April. Courtship behavior was first observed on 17 February 1959. Although an occasional pair may be seen on lakes in the spring, I have not seen evidence of nesting. In the fall the first flock of 11 males was noted on 4 November.

*Histrionicus histrionicus*. Harlequin Duck. This species is present throughout the year at Amchitka, as it is reported to be throughout the remainder of the Aleutians. According to Murie (1959) its status as a breeder in the Aleutian area is uncertain. On Amchitka I have seen no indication of nesting and have seen this duck only on salt water. It feeds by diving and foraging among rocks exposed at low tide. The stomachs of three individuals taken on 21 April 1959 all contained the same food items. The total number of individual food items is summarized in order of abundance: *Littorina*, 301; chitons, 15; amphipods, 7, limpets, 4.

*Somateria mollissima*. Common Eider. Although this species may be present near Amchitka throughout the year, it is scarce and occurs offshore between

mid-October and April. The first seen were two females, 1.6 kilometer (1 mile) offshore, on 26 February. The first eiders seen on rocks were eight females and three males at St. Makarius Point on 25 March. Pairing appears to occur in early or mid-May, and many pairs remain in flocks of up to 10 birds until nearly mid-June. Egg laying begins about 8 to 10 June and continues into late June. Mating was observed on 24 June. The first young, a brood of four, were seen on 2 July. The majority nest on offshore islets, but a few widely separated nests were found on the main island. The Kirilof Islets, at the mouth of Constantine Harbor, is one of Amchitka's important nesting areas. Lensink and I conducted a nest census of the three main islets on 8 July 1956. The data are summarized below:

<i>No. nests</i>	<i>Nest contents</i>	<i>Total eggs or young</i>
4	1 egg	4
9	2 eggs	18
13	3 eggs	39
20	4 eggs	80
8	5 eggs	40
5	6 eggs	30
1	6 newly hatched	6
5	young hatched and gone	20 (est.)
—		—
65		242

Little predation occurs during incubation. The nests are usually well hidden in clumps of *Elymus*. Gulls nesting nearby were not seen to rob any nests during our census. Rats are apparently unable to get at the eggs during incubation. There are no foxes on the islets. Shortly after hatching, the young are led to the water by their mothers. From this time appreciable loss occurs, probably to rats when the broods are brought ashore at night. Gulls have not been seen to take the chicks but undoubtedly do get some of them. Jones (*in litt.*) saw "Bald Eagles take the young off the water" in the summer of 1960. Within a few weeks after hatching it is not unusual to see groups of three or four ducks with only five or six ducklings among them. In late summer and fall, mothers and young congregate into a single group near the head of Constantine Harbor. By this time, among this nesting group, approximately 40 to 70 young remain alive.

*Melanitta deglandi dixonii*. White-winged Scoter. In his review of the distribution of this species, Murie (1959) indicates that its frequency of occurrence decreases toward the western Aleutians. Observations at Amchitka confirm this. The birds are, however, present there in the winter in small flocks of 2 to 12 birds. Prior to mid-March they were seen only on the open sea about 3 kilometers offshore. On 17 March two pairs were seen in Constantine Harbor. From this date until late April, five or six were always present there. An adult male (USNM 466787), food diving in 23 meters of water, weighed 1,247 grams, and the stomach contained the remains of four or five green sea urchins (*Strongylocentrotus drobachensis*) 15 to 20 mm. in diameter. The testes were enlarged, but I have seen no indication of nesting at Amchitka.

*Mergus serrator*. Red-breasted Merganser. The nesting of this species on Amchitka was established by Beals' observation of a brood of seven young on 3

September 1944 (Gabrielson and Lincoln, 1959). Single birds, pairs, and groups of three or four are present throughout the year, both on fresh and salt water, but they are not numerous. In midwinter they are quite scarce, becoming slightly more numerous in spring. Courtship behavior was observed on 3 April.

*Haliaeetus leucocephalus*. Bald Eagle. This species is common and may be seen at almost any time and any place on the island, except during storms when it seeks a sheltered perch on a leeward cliff or hillside. At least nine pairs nest annually on the eastern half of the island. Seven of the habitually used eyries are on the Bering Sea shore and only two on the Pacific side. Preference for the north exposure may reflect a tendency to avoid winds that prevail from a southerly direction during spring and summer months. Incubation may begin in early April but varies with individual pairs. On 12 April two pairs were seen incubating. Newly hatched young have been found on 13 and 25 May and 23 June. Although it is not unusual that three young are hatched, it is seldom that more than one or two are successfully fledged.

During the period of intensive fox poisoning at Amchitka, in the early and mid-1950's, the eagle population was somewhat reduced. Several dead birds were found that had eaten poisoned pellets. Local reproduction and an influx of birds from other areas, however, quickly restored the population, and in 1959 it had apparently again reached its natural ceiling.

This eagle is primarily a carrion feeder, subsisting on marine mammal, bird and fish remains that wash ashore. Small items may be carried to nests or feeding stations, but a number of eagles visit or remain near large beached carcasses until they are consumed or washed away. On 27 October eight subadult and two adult eagles rested near a dead sperm whale. Similar numbers are often seen near large carcasses. Sea otters die in considerable numbers during late winter and early spring storms. Eagles attack the rotting carcasses through the abdomen, turning the skin inside out and leaving it attached to the skeleton only at the tail, digits, and head. Four or five eagles have been observed to thus clean all soft parts from an otter carcass in two to three days, leaving most of the skeleton and skin. Krog (1953) on the basis of the remains of three sea otter pups in an eagle nest concluded that the Bald Eagle is a predator of the sea otter. Jones and I have also found the remains of sea otter pups in eagle nests, but on the basis of many hours of field observation by Jones, Lensink, several Aleutian natives, and myself, in areas where both eagles and sea otters were present, I believe that eagles cannot be considered a predator of the sea otter. No one, to my knowledge, has seen an eagle attack a living sea otter. Frequently I have seen mother sea otters food-diving, the pup left floating on the surface, while eagles flew low overhead or rested on nearby cliffs. The otters at Amchitka show no fear of eagles. I have seen only one eagle pay any attention to an otter. This individual was eating a fish. The eagle swooped toward it, but the otter rolled over, holding the fish under water beneath its body, until the eagle passed. Since the eagle did not attack the otter's back, which remained above the surface, it was presumably interested only in the fish. Dead otter pups wash ashore at Amchitka with moderate frequency, particularly during the late winter-early spring stormy period. These are quickly found by eagles and being small are carried to nests. That an eagle would rarely take a living sea otter pup, left unprotected while its mother gathered food beneath the surface, must, of course, be considered a possibility. The sea otter population at Amchitka has now reached a population ceiling,

another indication that predation by eagles is negligible. Although eagles have been seen to take living birds, it is my conclusion that they seldom take a healthy adult unless it is in some way hindered from normal escape. At Amchitka, eagles are quick to take a gull or waterfowl wounded by gunfire. On many occasions I have watched eagles attempt to catch healthy waterfowl, cormorants, and gulls but without success. In flight, healthy birds easily avoid the clumsy flight of eagles, but Jones (*in litt.*) has seen diving ducks plucked from the water's surface by a swooping eagle. Eagles are rarely seen within a kilometer of the gull colony on the Kirilof Islets during the nesting season. Those that attempt to enter this area are quickly driven away by a swarm of attacking gulls. It appears most doubtful that the Bald Eagle could be considered an important predator on any species in the Amchitka area. Murie's data (1940) indicate that the Bald Eagle's diet is composed of 58.9 to 86.0 per cent birds. This is based on food remains in nests, and on pellet examinations. In some areas these data may accurately reflect food habits of this species. At Amchitka, however, such figures must be considered in the light of field observations. The remains of many mammal carcasses and large fish, on which the eagles at Amchitka subsist to an important degree, would not often be detected in pellets or at nests. The remains of birds and smaller mammals accumulate over a long period in nests. Such remains were noted to persist in recognizable form at an Amchitka eagle nest for several months. The degree to which the Bald Eagle actually subsists on birds in areas similar to Amchitka is probably less than data gathered from nests would indicate.

The plumage of the subadult Bald Eagle, which Murie (1959) discusses, is extremely variable, showing a wide range of markings intermediate between uniform brown and the adult plumage. Undoubtedly this condition has caused confusion in field identification of species. During 13 field seasons spent in the Aleutian and Pribilof areas, I have searched carefully for other species of eagles but have seen none. I observed an eagle resembling a Gray Sea Eagle (*Haliaeetus albicilla*), which proved, on close examination, to be a Bald Eagle in intermediate plumage. The occurrence of other eagles in the Aleutian-Pribilof area must be considered as accidental, and only occurrences substantiated by specimens should be accepted.

*Circus cyaneus*. Marsh Hawk. At least one individual remained on Amchitka from 20 October to 8 November. During this period it was repeatedly seen at several locations on the eastern half of the island. It was very shy, and attempts to collect it were unsuccessful. The abundance of rats and small birds apparently furnished an adequate food source. Several observations indicate that this species may rarely stray westward in the Aleutians (Murie, 1959).

*Pandion haliaetus*. Osprey. On 20 October 1957 one individual remained for several hours along the shores of Constantine Harbor, where it soared on updrafts along the bluffs and was studied through 7 x 50 binoculars. Although this species occurs in Kamchatka, no other record for the Aleutians has been reported.

*Falco rusticolus*. Gyrfalcon. The status of this species in the Aleutians previously was based only on sight records which indicated that it infrequently occurs there. A female taken on 8 November 1957 (USNM 465712) proved to be *F. r. obsoletus*. Its stomach was filled with the remains of a rat. On 28 February 1959 three Gyrfalcons were seen and a female taken (USNM 466315), which was identified as *F. r. uraleensis* > *obsoletus*. It weighed 1,729 grams, and the stomach contained the remains of a rat. On 10 March 1959 one was seen on Kirilof Point

and another in the same area on 25 March. On 5 April three were seen at Rifle Range Point, and on 12 May one was seen in the same area. All birds were of the dark phase. This species apparently visits Amchitka sporadically in the fall to spring period, particularly in late winter or early spring during or shortly after periods of westerly circulation. I have seen no indication that it nests on Amchitka. Bond (1949) has shown that diagnostic characters of *F. r. obsoletus* and *F. r. uraleensis* overlap. The Amchitka specimens appear to be from this zone of intergradation. It would appear that more specimens from breeding populations of the several races must become available before the origin of winter migrants can be properly established.

*Falco peregrinus*. Peregrine Falcon. This falcon is most abundant on Amchitka during summer and fall months. During these seasons a man on foot anywhere on the eastern half of the island is frequently escorted by one, usually in immature plumage, watching for rosy finches (*Leucosticte tephrocotis*) or Lapland Longspurs (*Calcarius lapponicus*) that take wing. Also one could be seen near any pond or lake frequented by waterfowl. In winter and spring they are relatively scarce. On cliffs of the eastern half of the island I noted the approximate locations of two eyries and found a third. On 17 June 1956 it contained one half-grown young. Incubation appeared to be in progress on 1 March 1959. Apparently most of the birds hatched the previous season leave Amchitka before the breeding season.

*Falco columbarius bendirei*. Pigeon Hawk. A male (USNM 466314) in subadult plumage was taken on 5 February 1959. It weighed 113 grams, and the stomach contained remains of a rosy finch. Sight records were obtained: last week in May 1956, one seen on two successive days; 31 January 1959, one seen; 7 February 1959, one seen; 10 March 1959, two seen; 26 March 1959, one seen. Those that could be clearly observed were in heavily streaked subadult plumage. I suspect that individuals remained at Amchitka only a day or two and then left the island. Twenty-five to 30 kilometers were covered almost daily on roads. If the birds had remained for several days, they would undoubtedly have been seen in favorite places, which appeared to be the Kirilof Point and Rifle Range Point areas. On the basis of the above observations, this species might be considered a scarce but regular winter and spring visitor at Amchitka. Murie (1959) considers this species rare in the Aleutians and mentions only two specimens from Unalaska, plus a sight record from Adak and another from Kiska.

*Lagopus mutus gabrielsoni*. Rock Ptarmigan. In 1955, 1956, and 1957 this Ptarmigan was quite scarce. It was much more abundant in 1959, perhaps because of the reduction of foxes. On a 22-kilometer (14-mile) drive 15 to 20 birds could regularly be seen in 1959, where only two to four were usually seen in previous years. In 1959, several flocks of 4 to 10 birds occupied the area between Kirilof Point and St. Makarius Point, where in previous years pairs or individuals were rarely seen. The summer plumage begins to appear in early March, and pair formation apparently begins in mid-March, when some of the birds leave the flocks. Crowing and courtship flights were first observed on 9 May 1959. Five adults were collected and are in the U.S. National Museum collection.

*Grus canadensis*. Sandhill Crane. This species is recorded from the Aleutians west of Unimak Island only at Bogoslof, Attu, and Agattu Islands (Murie, 1959). I have not seen it on Amchitka, but Jones (*in litt.*) observed three birds near Aleut Point from a distance of 50 meters on 10 and 11 June 1960.



*Haematopus bachmani*. Black Oystercatcher. Almost every point is occupied by a pair of oystercatchers. Except during storms the pairs are scattered. During winter and spring storms they gather in flocks in sheltered areas. The more violent the storm, the larger the flocks become. On 4 March 1959, when the wind was 110-130 kilometers (70 to 80 miles) per hour, a flock at St. Makarius Point numbered 27 birds. Again on 6 May, shortly after a storm began, a flock of 10 oystercatchers had gathered. After the storm had progressed for several hours, becoming more violent, 14 additional birds had joined the flock. Fresh eggs were found on 23 May 1956, three; 29 May, two; and 7 June, one. An estimate, based on incomplete counts, places the resident population at 80 to 100 pairs on the eastern half of Amchitka.

*Pluvialis dominica*. American Golden Plover. This species stops, and then, briefly, at Amchitka during migration. One was seen at Makarius Point on 11 June 1956, and a flock of four seen on 18 October 1959 at the head of Constantine Harbor, when disturbed, circled to 150 meters and then headed south. The dearth of other records indicates that Amchitka may be between routes of migration of this species, which breeds in North America and Asia.

*Arenaria interpres*. Ruddy Turnstone. I saw a few small flocks and stray individuals on Amchitka during the latter half of October 1957, and Jones (*in litt.*) saw three small flocks in August 1960. Apparently this island is not on the main migration route of this species. Many hundreds stop on the Pribilofs in late summer.

*Tringa glareola*. Wood Sandpiper. During the first two weeks in June several individuals were seen on fresh-water marshy areas. Two were collected on 10 June 1956, but one was eaten by a rat before it was prepared. The other (sex unknown) was preserved (USNM 464728). One other specimen was taken on St. Paul Island in 1954. Previously, the species was represented on the North American list by only one specimen taken on Sanak Island on 27 May 1894 (Littlejohn, 1904). More careful observation might reveal that this species stops regularly at Amchitka in small numbers during migration.

*Heteroscelus incanum*. Wandering Tattler. The first fall migrant was seen on the shore of Constantine Harbor on 10 August 1955. Several other individuals have been seen, but unfortunately I failed to keep a record of the dates. It is an uncommon migrant.

*Erolia ptilocnemis couesi*. Rock Sandpiper. During October and November small flocks of up to 10 birds were seen feeding on marshy upland tundra areas, and scattered individuals and small groups frequented the beaches. In winter months they gathered in large flocks. From January through March few were seen scattered along beaches or on uplands. During this period a concentration varying from 50 to 160 birds was noted daily on the rocks near Kirilof Dock where the birds rested at high tide and fed at low tide. By 21 April the flock was reduced to 15 birds, the majority having moved to fresh-water or upland areas. By 5 May all had left the dock area, and pairs were seen occupying territories well away from beaches. A small number, usually single birds, frequented the beaches.

*Erolia alpina pacifica*. Dunlin. On 26 January 1959 a lone male (USNM 466312), weight 50.5 grams, was collected on the sand beach at the head of Constantine Harbor. This appears to be the first specimen taken in the Aleutians. It apparently strays into the Aleutians only rarely and has previously been re-

corded on the basis of sight records at Umnak (Murie, 1959), and Adak (Taber, 1946).

*Limosa lapponica baueri*. Bar-tailed Godwit. I have seen six birds on the beach at the head of Constantine Harbor. On 3 June 1956 three specimens, two males and a female (USNM 464725, 464726, and 464727), were taken from a flock of four. On 14 May 1959 two were seen and taken; both were females (USNM 466323 and 466324), and weighed 198.5 and 127.6 grams, respectively. They had little subcutaneous fat. In late May and early June of 1960 Jones (*in litt.*) "saw a flock of about 200 from which three were collected. [The flock] stayed for quite a while and we saw small numbers at widely separated points." Although there are comparatively few records of this species for the Aleutians (Murie, 1959), it is apparent that migrants stop regularly at various points throughout the Aleutians.

*Crocethia alba*. Sanderling. On 23 April 1959 Jones found a flock of 11 Sanderlings on the sand and cobble beach at the head of Kirilof Bay. On 25 April they were still in the same area, and we took three (USNM 466831, 466832, and 466833), two females and one male. A male obtained by Beals on 7 February 1941 at Amchitka (Murie, 1959) is apparently the only other record for the Aleutian Islands.

*Lobipes lobatus*. Northern Phalarope. During summer months scattered pairs occupy some of the shallow lakes and ponds. During dory trips near Amchitka in August of 1960, Jones (*in litt.*) obtained the following observation: "We saw a large flock (about 150) 2 or 3 miles off the Crown Reefer and another in the middle of Oglala Pass."

*Stercorarius parasiticus*. Parasitic Jaeger. A pair in dark plumage was first seen on 12 May 1956 beyond the air strip on the east end of Amchitka. During the remainder of May and June one or two pairs were seen whenever we visited this area. Krog (1953) reports it as nesting, but we did not find nests.

*Larus glaucescens*. Glaucous-winged Gull. This gull is numerous at Amchitka throughout the year. A colony on the Kirilof Islets is composed of about 100 pairs. On 10 March 1959 several individuals had taken territories. Mating was observed on 18 May 1956. On 21 May four nests with two eggs and one nest with one egg were found in addition to several nests in which no eggs had yet been laid. By 23 May about 15 nests contained three eggs. On 3 July two nests were found with hatching young. By 8 July the colony contained freshly laid eggs, hatching eggs, and chicks in all stages of growth, some showing pin feathers. The prolonged nesting period may have been a result of our visits to the colony early in the season.

*Sterna paradisaea*. Arctic Tern. A flock of about 20 birds was frequently seen during spring and summer at Crown Reefer Point. These birds behaved as if nesting, but I was unable to find nests in that area. Krog (1953) found this species "... nesting quite commonly in the interior of the island." This was not the case during the period of my observations or of Jones (*in litt.*). One pair nested on the Kirilof Islets. A fresh egg, which later hatched, was found on the large Kirilof Islet on 13 June 1956, and Jones found one fledgling on St. Makarius Point 24 July 1960.

*Uria lomvia*. Thick-billed Murre. This murre is scarce at Amchitka. Lone individuals occasionally enter Constantine Harbor. During the six-kilometer



dory trip along the north shore of the eastern half of Amchitka, between Constantine Harbor and East Cape, we seldom saw more than four to six individuals. Perhaps fewer than a dozen pairs nest along this coast, and I have seen no indication of nesting on the south shore. During aerial surveys around the island, I have seen no indication of a large colony. The Common Murre (*Uria aalge*) is apparently absent from the island.

*Cephus columba*. Pigeon Guillemot. Approximately 15 pairs enter Constantine Harbor in mid-March, and about half this number nest in May on beams under Kirilof dock. During the winter we found the birds scattered and usually about two kilometers offshore. Krog (1953) saw no evidence of nesting in May of 1952. A female (USNM 464732) taken on 7 May 1956 was identified as intermediate between *C. c. kaiurka* and *C. c. columba* by Aldrich. Two females (USNM 466792 and 466829) collected on 26 February and 23 March, respectively, have been identified as *C. c. columba*. Storer (1950) presumed that *kaiurka*, the Commander Island race, extended eastward to Umnak. These specimens support, in part at least, the conclusion that Amchitka is in a zone of intergradation between the two races. A larger series should, however, be collected at various islands of the outer Aleutians.

*Synthliboramphus antiquum*. Ancient Murrelet. This murrelet was seen frequently on Constantine Harbor and in the vicinity of the Kirilof Islets in spring and summer. Flocks usually numbered fewer than 10 birds. The earliest observation was a flock of five on 23 April 1959. The species may breed at Amchitka, but I have not found eggs.

*Cyclorhynchus psittacula*. Parakeet Auklet. This species is scarce at Amchitka. We found them singly or in pairs from 1-1.5 kilometers offshore in winter and spring months. In the course of a six-kilometer dory trip we seldom saw more than two or three. I have never seen it on cliffs, and if it nests at all on Amchitka it does so in very small numbers.

*Aethia cristatella*. Crested Auklet. This species is scarce at Amchitka. During the summer a few scattered individuals were seen on dory trips, usually about a mile off the north shore. On a six-kilometer dory trip from the mouth of Constantine Harbor, six were recorded. I have not seen it on cliffs, and if it nests at all on Amchitka it does so in very small numbers.

*Aethia pusilla*. Least Auklet. This species is usually scarce at Amchitka. During fall, winter, and spring, birds were seen singly or in groups of two or three about a mile off the north shore. In the winter of 1952, however, Jones (*in litt.*) found them abundant off Amchitka. The largest number that I recorded on a six-kilometer dory trip was 18 on 23 April 1959. I have seen no indication of nesting.

*Fratercula corniculata*. Horned Puffin. This species is scarce at Amchitka. During winter and early spring occasional single individuals were seen about a mile offshore. Three or four pairs nest each year under Kirilof dock. Aside from these, I have seen no indication of nesting.

*Lunda cirrhata*. Tufted Puffin. This species was seen throughout the year, but it was scarce and well offshore in the winter. The first birds were seen at the Kirilof Islets on 9 May, where there was a colony of about 50 to 70 pairs. A few additional pairs nest in burrows near the tops of cliffs on Kirilof Point. Several heavily incubated eggs were found on 8 July.

*Nyctea scandiaca*. Snowy Owl. A single individual was seen several times

during the summer of 1956, and two were seen during the winter and spring of 1959. The birds were always seen on the rolling uplands near the middle of the island, except after a heavy snowfall, when one was seen on the east end of the island on 16 February. No indication of nesting could be found.

*Asio flammeus*. Short-eared Owl. On 26 June 1956 an individual, dead several days, was found at East Cape. On 28 June one was seen flying across the tundra near the airstrip. On 21 February 1959 a male (USNM 466316), weighing 340 grams, was taken on St. Makarius Point. Its stomach contained only a fresh dropping, probably from a Rosy Finch. There were heavy layers of subcutaneous and abdominal fat. This species nests as far west as Unalaska Island but apparently wanders more or less regularly westward to Attu (Murie, 1959).

*Corvus corax*. Common Raven. The raven was formerly resident on Amchitka (Jones, *in litt.*). The fox-poisoning program has, however, now eliminated the resident population, but occasional pairs visit the island. In 1955 a pair was seen only once on 26 September. In 1956 two pairs remained in the vicinity of Constantine Harbor during part of the summer. In 1957 two pairs were present during the first two weeks of October. These occurrences might indicate that the species will eventually become re-established on Amchitka.

*Troglodytes troglodytes tanagensis*. Winter Wren. Dall (1874) noted that young Winter Wrens were "very plentiful" on Amchitka in July 1870. Murie, quoting from his 1937 field notes, says (*in litt.*): "Winter Wrens are particularly common on this island." In 1937 he found two nests there (Murie, 1959). Although I searched diligently for wrens in all seasons, I saw only one in the 1955-1959 period. This one, a male (USNM 465418), was located by Krear on 4 November 1957, feeding in cracks on the face of a beach cliff 1.5 kilometers southwest of South Bight. Of this specimen Aldrich (*in litt.*) says, "Your Winter Wren specimen proved to be a surprise since it belongs to the race *tanagensis* rather than *kiskensis*, the form which was formerly recorded from Amchitka." I know of only one additional observation of wrens there since World War II. In May 1955 Jones (*in litt.*) saw one on the islet off Chitka Point. Aside from the rats introduced on Amchitka during the 1940's, no other ecological change is evident, so it may therefore be assumed that the rats exterminated the wren population. Nesting wrens would be most vulnerable. They nest among rocks and tumbled-down structures along beaches in locations easily accessible to rats, abundant in these areas. It is interesting to note, in this respect, that this wren is not recorded from Rat Island (Murie, *in litt.*). The 1957 specimen of *tanagensis* was undoubtedly a wanderer from an island east of Amchitka. Since this race has not previously been recorded from Amchitka, the question is suggested as to what extent interisland wandering and subsequent establishment of individuals in populations of another race takes place.

*Turdus obscurus*. Dusky Thrush. A male (USNM 464735), with testes approaching breeding condition and much body fat, was first seen searching for food beside a stream emptying into Cyril Cove on 27 May 1956. It was quite wild but remained in the same general area during a half hour of stalking. On 19 October 1957 another individual was seen on a sheltered beach among the *Elymus* about two miles southwest of South Bight. This individual was so wild that it could not be taken. This species, which breeds in northeastern Siberia, is a new addition to the North American list.

*Phylloscopus borealis examinandus*. Arctic Warbler. In mid-October of 1957

a number of these birds apparently visited Amchitka. A male (USNM 465415) was taken on 17 October and another (USNM 465421) on 23 October. Both specimens contained much subcutaneous and abdominal fat. Five individuals were seen between 15 and 23 October, at the following locations: head of Constantine Harbor, end of St. Makarius Point, and head of St. Makarius Bay. All frequented upper beach areas where they foraged about the stalks of *Senecio* and often disappeared among the *Elymus* clumps. The two specimens constitute the first records of the occurrence of this Asian subspecies of Arctic Warbler on North American soil. This race breeds on the Kamchatka Peninsula and on the Commander Islands.

*Muscicapa griseisticta*. Gray-spotted Flycatcher. On 1 June 1956 Bennett took a female (USNM 464740) having considerable body fat. It was near Kirilof dock and perched on a pile of old timbers, from which it flew several times in pursuit of insects. The stomach contained broken parts of insects. These were examined by R. H. Foote and C. W. Sabrosky of the Division of Insects, U.S. National Museum, who gave the following identifications: various species of *Phaonia*, *Hydrotaea*, and *Scopeuma*, and an unidentified helemomyzid. This is the first North American record of the Gray-spotted Flycatcher. Its nearest known breeding place is Kamchatka. Apparently this specimen is the first member of the family Muscipidae to be taken in North America. Aldrich says (in litt.): "This specimen matches the unique type of *Butalis pallens* Stejneger (1887), obviously a member of the species *Muscicapa griseisticta* from Bering Island, in its pale coloration. It is different in this respect from all other specimens of the species in the U.S. National Museum. If, after collection of additional material from Bering Island, *pallens* proves to be distinct, the Amchitka Island specimen should be referred to this race."

*Motacilla alba*. White Wagtail. On 19 May 1956 one individual was seen near Kirilof dock. Snow Buntings chased it persistently, and it several times sought refuge near an abandoned warehouse. It was so wild, however, that in an hour of stalking it could not be taken. This species is rare in the Aleutian area. The Asian race *lugens* has been collected on Attu, and there are several sight records of the species from there (Murie, 1959).

*Motacilla flava similis*. Yellow Wagtail. On 25 May 1956 a pair of Yellow Wagtails was seen near the beach at the western corner of Constantine Harbor. The birds were extremely wild, and efforts to take them were fruitless. On 26 May the birds were again seen in the same location. Bennett, after an hour of stalking, was able to obtain one, a male (USNM 464738), having considerable body fat. These are the only Yellow Wagtails that I have seen on Amchitka. This would indicate that the race breeding in northern Alaska does not migrate through the Aleutians, as once supposed (A.O.U., 1931), and that one seen on Attu (Turner, 1886) probably belonged to the eastern Siberian race. The specimen here reported is the first record of this race for North America.

*Anthus spinoletta pacificus* and *japonicus*. Water Pipit. It is not unusual to see pipits on the beach at the head of Constantine Harbor in summer and fall. Only one specimen, sex undeterminable (USNM 465413), was taken from a group of three seen there on 14 October 1957. This proved to belong to the Asian race *japonicus*, which has previously been recorded only from St. Lawrence and Nunivak Islands (A.O.U., 1957). In the late winter and spring of 1959 the species was searched for, but only one flock of four birds, among a flock of 25 Snow

Buntings, was seen on 27 February. One of these, a male (USNM 466325) weighing 22.6 grams, was taken. It has been identified as *pacificus*, the race reported commonly throughout the Aleutians in spring and summer.

*Fringilla montifringilla*. Brambling. Late in the afternoon of 14 October 1957 two fed in an open grassy area near the beach at the western corner of Constantine Harbor. The following morning three birds were found at the same location and, one, an adult male (USNM 465414), was taken. On 17 October a flock of eight was found feeding in the same location. They were wary and when frightened flew several hundred feet in the air before heading inland. The only other record of this species for North America was taken at St. Paul Island, Alaska, on 25 October 1914 (Hanna, 1916).

*Leucosticte tephrocotis griseonucha*. Gray-crowned Rosy Finch. This bird is abundant on Amchitka. Unlike the Winter Wren and Song Sparrow, it often nests on inaccessible cliffs and on rafters in buildings where it is usually safe from rats. Nesting begins in early May. Hatching eggs were found on 18 May. Usually two and sometimes three broods are raised. Flocks of 10 to 20 birds form in late summer. During stormy periods, particularly in February and March, these small flocks join into larger ones, often of 50 to 60 birds. During a storm with winds of 110 to 125 kilometers per hour on 4 March 1959, one flock was estimated at about 150 birds. After storms the large flocks again separate into smaller ones. The flocks break up and pairing begins at the end of March.

*Acanthis flammea flammea*. Common Redpoll. On 1 March 1959 a female (USNM 466326), weighing 14 grams and having much body fat, was taken while it fed among dead grass patches on beach cliffs southwest of South Bight. One other Redpoll, seen during a storm on 6 May 1959, was quickly carried away by the wind and could not be taken. Sight records of Redpolls, presumed to be this species, have been recorded for several localities in the outer Aleutians (Murie, 1959).

*Junco hyemalis hyemalis*. Slate-colored Junco. On 4 November 1957 a male (USNM 465419) having much body fat was taken while feeding among *Elymus* clumps near a small stream southwest of South Bight. Krear had observed it in this location several hours before it was taken. Although this species has been taken on the Pribilof Islands (Hanna, 1919), it has not been recorded previously from the Aleutian Islands.

*Melospiza melodia*. Song Sparrow. Not one Song Sparrow was seen on Amchitka in the 1955-1959 period. Murie (*in litt.*) recorded in his field notes that it was common there in July of both 1936 and 1937. Krog (1953) does not mention the species. It was apparently exterminated on this island after the introduction of rats during World War II. Like the Winter Wren, now also gone, it frequented the coast where it nested on grassy slopes easily accessible to rats.

*Calcarius lapponicus alascanis*. Lapland Longspur. This species is an abundant summer resident on Amchitka. Its habitat includes all areas on the eastern half of the island. This fact undoubtedly renders it safe from excessive predation by rats. The first male was seen on 27 April 1959. Males continued to arrive in increasing numbers until reaching maximum abundance on 10 May. By this time most had chosen song perches and were defending territorial boundaries. By 20 May 1959 when I left Amchitka, no females were seen, but on 27 May 1959 several were noted at Adak. The first nest with hatching young was found on 11 June 1956, and heavily incubated eggs were found on 17 June. The majority

apparently leave in September, but two stragglers, both females, were seen on 17 and 19 October, and one, a female (USNM 465420) having little body fat, was collected on 13 November 1957.

*Plectrophenax nivalis townsendi*. Snow Bunting. Singing was first heard on 24 March 1959. Pairs and males singing from perches were seen until 10 April, when males were seen in song flight. The first finished nest (but no eggs) was found on 21 May 1956, and a nest containing four fresh eggs was found on 26 May. Nestlings in pin feathers were found on 9 June, and four newly hatched young on 15 June. By 26 August young were seen in new fall plumage. In early winter most birds were seen inland and on high ground in flocks of 5 to 10 individuals, but when snow covered the ground the size of flocks increased. One of more than 100 birds was seen on 15 February 1959. Nesting takes place in all suitable habitats, both inland and in cliffs and among rocks near the shore. The species is present throughout the year, but in winter seldom frequents shore areas. The first individuals were seen at the shore, near Kirilof dock, on 10 March, and four or five pairs nested in cliff crevices of this area. The narrow crevices in which they nest, the inaccessibility of many of these areas to rats and the diversification of nesting sites, from the shore to the highlands, have probably protected this species from serious rat predation.

*Emberiza rustica latifascia*. Rustic Bunting. On 20 October 1957 a male (USNM 465416) was heard calling from a *Senecio* stalk among *Elymus* clumps near the beach on the east side of Constantine Point and taken. On 27 October a second (USNM 465417) was taken in exactly the same place. This bird was badly damaged by shot, and sex was not determined. Both birds had a large quantity of subcutaneous and abdominal fat. This Asian species is represented in North America by only three other specimens taken in June 1911 by Wetmore and McKechnie on Kiska Island (Murie, 1959).

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## THE MIGRATION OF LAPLAND LONGSPURS TO ALASKA

LAURENCE IRVING

EARLY in May Lapland Longspurs, *Calcarius lapponicus*, arrive at Anaktuvuk Pass in the center of the Brooks Range of arctic Alaska in large flocks that fly swiftly northward in compact formations or stop to feed among the hummocks of sedge that are exposed through the snow (Irving, 1960a). Judging from my observations, verbal reports, and compilations by Gabrielson and Lincoln (1959), these longspurs are generally the commonest nesting species of the Alaskan arctic tundra. They also nest in western Alaska over the grassy land beyond the forests as far south as the Alaska Peninsula, on St. Lawrence (Fay and Cade, 1959) and other islands in the Bering Sea (Preble and McAttee, 1923), and along the Aleutian Islands to Attu (Murie, 1959).

Published reports (Friedmann, 1935) show the occurrence of Lapland Longspurs on Kodiak. Unpublished reports (Fish and Wildlife Service) indicate that they are common summer residents in the Kodiak National Wildlife Refuge, which comprises a large part of Kodiak Island. The extent of their presence on Kenai Peninsula is not clearly shown in publications. Comments of residents on the northwestern shore indicate that longspurs pass that part of Kenai in migration. Nesting probably occurs on Kodiak and possibly on Kenai, but I have not been able to verify this.

On Middleton Island in the Gulf of Alaska (Rausch, 1958), the nesting of longspurs is detached from their arctic and western Alaskan nesting grounds. They have also been reported nesting in the interior of Alaska at Mt. McKinley National Park (Dixon, 1938); and, according to Gabrielson and Lincoln (1959), George Schaller found them nesting at Black Lake in the Talkeetna Mountains.

Except for the reported nesting of longspurs in these mountainous areas of the interior, the nesting population of the mainland of Alaska is settled in a peripheral band about its arctic and western perimeter (Figure 1). South of Barrow this heavily populated band extends from the coast about 320 kilometers (200 miles) inland to the forest. Elsewhere on the mainland the densely occupied nesting area is no wider, but it extends to the islands in the Bering Sea, southwestward along the Alaska Peninsula and for some 2,200 kilometers (1,400 miles) into the Pacific Ocean over the Aleutian Islands. Since longspurs are the commonest birds nesting over this great area, they are one of the most numerous avian populations in northwestern America.

The breeding Lapland Longspurs of Alaska are ascribed to the subspecies *C. l. alascensis* Ridgway (A.O.U. Check-list, 1957) and are said to winter in interior western states and as far north as southern British Columbia (Munro and Cowan, 1947). Taking latitude 50° and longitude 134° as reference points for the northwestern part of this wintering area, their migration would extend 20° of latitude northward and 14° of longitude westward to the eastern nesting limits of the race in

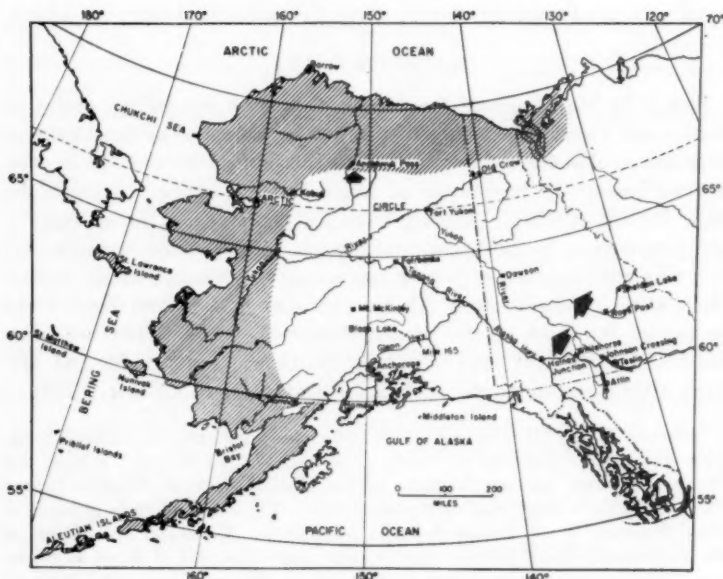


Figure 1. Northwestern range of *Calcaeus lapponicus* (diagonal hatched) and location of well-recorded directional migration in spring (heavy arrows).

Mackenzie (A.O.U. *Check-list*, 1957). In the westernmost Aleutian Islands the migration would extend their summer range only 4° northward but 67° westward. During several years I have been gathering evidence for the course and program of this extended and large migration in Alaska.

#### MIGRATION THROUGH THE BROOKS RANGE

From 1948 to 1960 Simon Paneak, a resident of Anaktuvuk Pass (latitude 68° 19' N., longitude 151° 26' W. in the central part of the Brooks Range), recorded for me his observations of birds and those of his family and neighbors. In 1949 Thomas Brower kept records there during April, May, and June. These observations are supported by many specimens. I have been at Anaktuvuk during all or part of five spring migrations. In 10 years of suitable records the first Lapland Longspurs were recorded at Anaktuvuk on 1 May 1949, 29 April 1951, 9 May 1952, 4 May 1953, 13 May 1954, 5 May 1956, 8 May 1957, 3 May 1958, 11 May 1959, and 29 April 1960; the average date of these arrivals being 5 May.



The dates of first recorded arrivals of longspurs are more variable than for many arctic species. The daily records of migrations during eight years are complete enough to show that after their first arrival on the average date of 5 May only a few longspurs, usually identified as males, were seen before the average date of 17 May (11 to 20 May). On that average date flocks of 40 or "many" first appeared. Thereafter, for 10 days, numbers recorded by Tom Brower were as large as 2,000 a day in flocks that commonly included from 50 to 150 longspurs. Until about 20 May the flocks included mainly males, but thereafter the proportion of females increased. The less conspicuous appearance and behavior of female longspurs may have biased reports, but we have not noticed a late excess of females that would offset the obvious early preponderance of males.

Like pipits, *Anthus spinoletta* (Irving, 1960b), and several other species, the first male longspurs arrive at Anaktuvuk fat and with partially developed testes (Irving, 1960a, p. 123). After 15 May the testes had reached full breeding size, and flight songs began to be noticed among coherent flocks that were apparently still migrating northward. Pairing was recorded as early as 20 May, nest building a few days later, and first eggs just before 1 June in most years. In the confusion of so many migrating flocks I did not discern whether entire flocks separated and settled at Anaktuvuk or whether individuals dropped out as they paired and nested there while the remainder of the flocks continued northward.

The great northward migration of longspurs through Anaktuvuk continues for about 10 days after the average date of 17 May and intermittently for a few more days. The large numbers that remain to nest are an insignificant part of the many flocks that pass swiftly northward or occasionally alight to feed and drink busily as if in haste to continue. Occasionally a flock has been watched while grounded for several hours, but I have not searched to find if the migrants roost overnight in the valley. Sometimes a flock circles or makes a short flight, and on a few occasions flights have been seen to pass southward out of view. In most of the flocks the movement is well coordinated, closely organized, and pursues its course northward. I have gained the impression that the northward movement of longspurs at Anaktuvuk is as pronounced a directional migration as is the tremendous movement of eider ducks flying eastward in spring along the arctic coast past Barrow. The longspur is the most numerous migrant to pass Anaktuvuk in spring, and many thousands are transferred toward the arctic slope.

Although the Nunamiut Eskimos now are based at Anaktuvuk Pass,

their older people have lived in many valleys of the Brooks Range between longitude 150° and 158°, which their ancestors occupied as nomadic caribou hunters. These Eskimos named six other valleys through which longspurs migrate northward in numbers comparable with or exceeding the migration at Anaktuvuk and indicated that all valleys were utilized according to the extent of their grassy land. I have seen their migration through the Killik Valley and Howard Pass.

Records from Anaktuvuk show that the earliest reports of longspurs in spring differ from year to year more than is the case for other arctic migrants, each species of which commonly arrives within a few days of its regular date. Further, as a result of close observation by resident people, it is apparent that after the earliest longspur was noticed, on the average 12 days elapsed while only a few individuals, mostly males, were seen until numerically significant migration in flocks began suddenly and continued for 10 or 15 days. This rather unusual program of migration may be peculiar to the longspurs at Anaktuvuk; or it may be that the observation of migration by many Eskimos resident in open tundra, where visibility is especially good and migration is constricted in a narrow valley, detects the few early migrants that escape the view of single observers at less favorable positions.

#### MIGRATION ELSEWHERE IN THE WESTERN ARCTIC

Longspurs nest near Kittigazuit in the Mackenzie Delta (Porsild, 1943). Several reports of migration and nesting on the arctic coast of Yukon Territory have been compiled by Rand (1946), and Kessel and Schaller (1960) recently found a few nesting near the headwaters of the Sheenjek River in the northeastern Alaskan Brooks Range. We did not find them in the valley or on the tundra within 16 kilometers (10 miles) north of Old Crow, Yukon Territory (Irving, 1960a).

While watching the spring arrivals at Demarcation Point and Humphrey Point, respectively, in 1914, Brooks (1915) and Dixon (1943) reported that a few longspurs arrived there to nest. From their accounts and from the reports of Eskimos who have lived on the eastern arctic coast of Alaska, I have concluded that there is no evidence for a westward migration passing from Mackenzie Valley coastwise into Alaska (Irving, 1960a).

Alfred Bailey (1948) reported that longspurs seemed suddenly to arrive at Barrow and all along the western arctic coast in the third week of May. During the 1st International Polar Year John Murdoch (1885) reported their arrival at Barrow on 20 May 1880. Since migration coastwise along the northeastern Alaskan coast has not been re-

ported, I have taken for granted that migrants to the arctic slope and coast came with the many flights that have been seen passing through the valleys of the Brooks Range.

Max C. Thompson informed me that during the spring of 1960 he and several other ornithologists (Williamson, *et al.*, unpublished) who watched throughout the spring and summer at Cape Thompson (latitude  $68^{\circ} 15'$ , longitude  $166^{\circ}$ ) saw no group of longspurs near that northwestern Alaskan coast greater than 10 and that during migration they noticed only about as many individuals as they subsequently counted while nesting. Many longspurs nest there, but it seems that the area is a terminus and not a through route for their migration. Leonard Peyton and I found many longspurs already nesting about Cape Prince of Wales and Lopp Lagoon on 15 June 1960, and Alfred Bailey (1948) reported that they were common there on 29 May 1922. His Eskimo associate, Dwight Tevuk, who has made many important collections at the tip of Seward Peninsula, recently informed me that many longspurs migrate at Wales early in the first part of May and that some have appeared on the coast from over the sea.

Longspurs have been reported in the interior Kobuk Valley (Grinnell, 1900), where I have also found them nesting in summer visits in 1954 and 1957. Late in May 1951 I saw many longspurs migrating northward through Howard Pass, and just east of there in 1952 we found them the commonest birds nesting along the valley of the Ahlasuruk River (Irving and Paneak, 1954).

#### MIGRATION IN THE PORCUPINE VALLEY AND NORTHERN YUKON

At Old Crow, Yukon Territory, Leonard Peyton and I first saw a longspur on 4 May 1957, and occasionally saw a few males until 12 May (Irving, 1960a). After that some females were also seen until 24 May, and groups as large as a dozen were occasionally seen flying eastward up the Porcupine River as if coming from the Yukon Valley. We did not find them nesting in the Porcupine Valley, but Kessel and Schaller (1960) found a few longspurs nesting in the Sheenjek Valley 200 kilometers (125 miles) northwest of Old Crow. While watching for migration at Fort Yukon in 1958, Peyton and Francis S. L. Williamson saw a pair of longspurs on 4 May, a male on 5 May, and a few on the edge of the airstrip on 6 and 7 May. Judging from the small numbers seen at Fort Yukon and Old Crow, the Porcupine Valley is not an important migratory route for longspurs coming to Alaska, and the northeastern part of their nesting range does not extend very far south of the arctic coast.

## OBSERVATIONS OF LONGSPURS MIGRATING WESTWARD TOWARD ALASKA

Since the early studies of Alaskan birds (E. W. Nelson, 1887 and 1913), it appears to have been commonly considered that the Lapland Longspurs nesting in Alaska winter in the interior western states. They are reported in winter as far north as southern British Columbia (Munro and Cowan, 1947) and migrate northward through the western Mackenzie Valley (Cooke, 1910 and Munro and Cowan, 1947).

In 1958, while Peyton and Williamson were proceeding to observe at Fort Yukon, I set out from Anchorage along the Glenn Highway to join the Alaska Highway and travel eastward through the Tanana Valley into southern Yukon Territory. I had compiled evidence (Irving, 1960a, p. 277) that observation along this course might be expected to find flights of a number of continental land birds migrating westward and northward into Alaska. I first identified longspurs on 24 April 1958, in a flock of 30 along the Glenn Highway, 265 kilometers (165 miles) northeast of Anchorage. The next flock of 50 was identified on 26 April, at mile 1,045 on the Alaska Highway at Boutilier Summit, Yukon Territory, between Kluane Lake and Haines Junction. On the fields of the Whitehorse Experimental Farm west of Haines Junction a compact flock of about 100 longspurs was milling about in rapid, swerving flight and occasionally alighting briefly on the stubble fields. Just beyond Whitehorse on 27 April a flock of 100 took off from the airfield and headed westward. In another flock of 100, which were drinking and feeding so busily that they appeared reluctant to fly, I examined 50 individuals with binoculars at close range and counted 48 males and two females. It had been my impression that in the six flocks noticed so far, most of the birds were males. The trend of their flights was westward.

Ninety-five kilometers (60 miles) east of Whitehorse at Johnson's Crossing over Teslin River many flocks of longspurs were flying swiftly down the river in the first days of May, occasionally swerving and sometimes circling before passing over the high bridge and embankment on the highway. Only one flock was observed to alight briefly on the flats along the river. In one period of five hours I noted that I saw flocks estimated at 2,500 birds flying northwest down Teslin River. I doubt if I noticed half of those passing within a half kilometer of my position, for I was walking about searching for other birds. The longspurs were not restricted to the flats of the Teslin River Valley, for I saw flocks moving westward over the high ground when I occasionally traveled on the highway.

As I was passing southward along the highway to Atlin, British

Columbia, on the east side of Lake Atlin on 2 May, I saw many flocks of longspurs in flight, a few alighted on the ground, and a few small groups perched in trees. I studied three of these flocks at close range as they fed on the ground and counted the proportion of females as one, two, or at most three among 10 birds. An automobile ahead of me had killed or wounded 15 longspurs from a flock on the Atlin Highway, and only three of them were females. At the village of Atlin there were several flocks of longspurs, one of which included about 200 birds, but they were apparently pausing in the village. During this day I estimated that I noticed about 40 flocks of from 20 to 150 longspurs, averaging about 50 birds or some 2,000 in all. The common direction of their flight was westward.

While with Charles Sheldon hunting for specimens of Dall's sheep on the Macmillan River, Osgood (1909) saw large flocks of longspurs early in September, and Rand (1946) saw them migrating in the same country in late summer. Many longspurs appear suddenly in spring at Dawson (Betts, 1940). The westward course of the spring migration of longspurs that I observed extended over the country between the Alaska Highway and Atlin for a width of 80 kilometers (50 miles) from north to south. Reports listed by Rand (1946) indicate that the migratory path in Yukon may extend 300 kilometers (200 miles) northward to the southern watershed of the Ogilvie Range. H. S. Swarth (1936) reported the first longspurs at Atlin, B.C., on 25 April 1930, 4 May 1931, 21 April 1934, and 11 April 1935; the average date for these four years being 22 April.

#### PROGRESS OF MIGRATION IN ALASKA

Taking 49 records of arrival in various years at 30 localities, the dates at 27 localities follow the average date of arrival in Atlin (Table 1). I have chosen Atlin as a reference point because a careful observer, H. S. Swarth (1936), observed there during the spring and summer of four years and because it is in the path of large migratory flights that I observed in progress westward. Migration to Mackenzie Delta is not likely to pass near Atlin, and arrival at Mountain Village four days after Atlin would require flight at the improbable speed of 413 kilometers per day. Omitting these records, the average advance of the front of migration from Atlin to 17 places in northern and northwestern Alaska was 88 kilometers per day, a distance that longspurs could travel in two hours.

Migrants may not be observed until some days after they arrive. Further, the arrival of longspurs has been variable from year to year

TABLE-1

DATA ON THE SPRING ARRIVAL OF *Calcarius lapponicus* IN LOCALITIES OF ATLIN, BRITISH COLUMBIA

Place (Alaska unless noted)	No. of years	Date of arrival	Latitude (degrees)	Longitude (degrees)	From Atlin days	Kilometers per day
Atlin, British Columbia (Swarth, 1936)	4	22 April	59 N.	134 W.	—	—
<i>Bering Sea and North of Atlin</i>						
1 Mackenzie Delta, N.W.T. (Porsild, 1943)		16 May	70 N.	134 W.	24	45
2 Old Crow, Y.T. (Irving, 1960a)		4 May	67 N.	140 W.	12	81
3 Demarcation Point (Brooks, 1915)		14 May	70 N.	141 W.	22	53
4 Humphrey Point (Dixon, 1943)		18 May	70 N.	142 W.	26	50
5 Fort Yukon (Irving, 1960a)		4 May	67 N.	145 W.	12	83
						Average 62
6 Fairbanks (Gabrielson & Lincoln, 1959)	2	3 May	65 N.	148 W.	11	88
7 Mount McKinley (Sheldon, 1930)		12 May	64 N.	149 W.	20	49
8 Anaktuvuk Pass (see page 2)	10	5 May	68 N.	152 W.	13	102
9 Barrow (Bailey, 1948)	3	20 May	71 N.	156 W.	28	60
						Average 75
10 Beaver Mountains (Gabrielson & Lincoln, 1959)		12 May	63 N.	157 W.	20	66
11 Kobuk (Grinnell, 1900)		20 May	67 N.	157 W.	28	54
12 Nulato (Dall, 1869)		12 May	65 N.	158 W.	20	70
13 St. Michael (Nelson, 1887)	2	1 May	63 N.	162 W.	9	176

		26 April	62 N.	164 W.	4	1,650	Average 91 (413)
14 Mountain Village (Gabrielson & Lincoln, 1959)							
-15 Hooper Bay (Brandt, 1943)	2	12 May	61 N.	166 W.	20	1,780	89
16 Cape Thompson (Williamson, <i>et al.</i> , unpub.)		2 May	68 N.	166 W.	10	1,830	183
17 Wales (Tennek, 1960)		5 May	65 N.	167 W.	13	1,900	146
18 Pribilof Islands (Preble & McAtee, 1923)	3	9 May	57 N.	170 W.	17	2,190	129
19 St. Lawrence Island (Pay & Cade, 1959)		20 May	63 N.	171 W.	28	1,980	71
19	Total 35						Average 124
<i>Alutian Islands and South Central Alaska</i>							
1 Dyea (Hartlaub, 1889)		21 April	59 N.	135 W.	—	—	—
2 Yakutat (Grinnell, 1910)		6 April	60 N.	140 W.	—	—	—
3 Tolsona Lake (interior) (see page 8)		25 April	62 N.	146 W.	3	740	245
4 Anchorage (Williamson & Peyton, unpub.)	3	24 April	61 N.	150 W.	2	910	460
5 Homer (Williamson & Peyton, unpub.)		19 April	60 N.	151 W.	~3	1,010	—
6 Cold Bay (Gabrielson & Lincoln, 1959)		5 May	55 N.	163 W.	13	1,800	140
7 Unimak Island (Murie, 1959)	2	23 April	55 N.	164 W.	1	1,930	1,930
8 Unalaska Island (Gabrielson & Lincoln, 1959)		8 May	54 N.	167 W.	16	2,130	133
9 Adak (Morse, 1946)		25 April	52 N.	177 W.	3	2,870	955
10 Amchitka Island (Krog, 1953)		25 April	51 N.	179 E.	3	3,180	1,060
11 Attu (Gabrielson & Lincoln, 1959)		2 May	53 N.	173 E.	10	3,580	358
11	14						



in localities that have been under sustained observation. Erroneous reports or erratic migration could cause these records to be late and so lead to calculations of slower than actual progress. Since it is a likely possibility that the swift-flying longspurs can travel 150 kilometers per day, a delay of five or even 10 days in any of these annual local records would, if corrected, still lead to a plausible calculation of the progress of migration.

Reports show that migration to the western coasts of the Gulf of Alaska evidently pursues a different schedule. The recorded arrival of longspurs at Dyce, Yakutat, and Homer preceded the records for Atlin. Among the nine other records from the south-central and southwestern coast and Aleutian Islands, only two (Cold Bay and Unalaska) follow arrival in Atlin by an interval sufficient to make the calculated progress of the van of migration within the possible speed of flight. The other five records would require flight from Atlin at an impossible speed. In these cases erroneously late records would only increase the improbability that flights to southwestern Alaska and the Aleutian Islands proceed through the headwater valleys of the Yukon River.

#### MIGRATION FROM ASIA TO ALASKA

Dr. Frank Pitelka informed me that from his observations at Point Barrow the Lapland Longspurs might arrive in northern Alaska from wintering in Asia. According to his comment, thousands of longspurs have been seen at Barrow flying from the west late in May and in the first part of June. Further, of 1,400 bands applied to longspurs at Barrow, none were recovered either from well-populated western America or from the interior of Asia that we know so poorly. If direction of migration can be inferred from flights observed at one point, Dwight Tevuk's remarks that longspurs appeared over water near Wales might also suggest migration from Asia.

Stejneger (1885) reported that longspurs first reached the Commander Islands on 21 April 1883, but the specimens from there were later assigned to the darker race, *C. l. coloratus* Ridgway (1898), which occurs in Kamchatka and adjacent Siberia (Vaurie, 1959). Olaus Murie (1959) repeated Ridgway's (1901) opinion that over the Aleutian Islands the longspurs did not differ from *C. l. alascensis* of the mainland. These reports indicate opinions that eastern Siberian longspurs do not migrate to the Aleutians.

Vaurie (1959, p. 706) observed that "possibly all or the majority of visitors to China are *coloratus*." That distinction indicates the unlikelihood that many of the light-colored *C. l. alascensis* winter in China and



suggests that the nearest Asiatic range in which to suspect that some Alaskan nesting longspurs might winter unrecognized among Eurasian *C. l. lapponicus* would be in Manchuria. The distance and direction of such a migration does not appear impossible for the swift-flying and sturdy longspurs, because populations of four smaller and weaker-appearing species of land birds, *Oenanthe oenanthe*, *Luscinia svecica*, *Motacilla flava*, and *Phylloscopus borealis*, regularly migrate from wintering in warm areas in Asia to nest in Alaska (Irving, 1960a, p. 270).

Longspurs nest on the Chukchi Peninsula adjacent to Alaska, but their migratory schedules and taxonomic characters have not been reported in detail that provides evidence for the extent and direction of exchanges of longspurs between Alaska and Siberia.

#### MIGRATION IN SOUTHEASTERN ALASKA

Migrating longspurs have been frequently reported in southeastern Alaska (Gabrielson and Lincoln, 1959), but the reports do not show that the coastwise migration is a great contributor to their nesting in Alaska. Longspurs nest on Middleton Island 120 kilometers (70 miles) south of the mainland in the Gulf of Alaska (Rausch, 1958). Considering that longspurs reach west Greenland from America early in May (Salomonsen, 1951), it would be possible for them to make extensive flights over the Gulf of Alaska to reach south-central and southwestern Alaska at the early dates when they appear.

#### MIGRATION OF LONGSPURS THROUGH WESTERN CANADA

In British Columbia longspurs migrate northward in numbers that pass mainly east of the Rocky Mountains (Munro and Cowan, 1947). These authors designated the longspurs of British Columbia *C. l. alascensis*. At Fort Simpson Preble (1908) considered 24 out of 33 longspurs collected soon after 25 April 1904 to be *C. l. alascensis*. In assigning the longspurs of Banks Island to *C. l. lapponicus*, Manning, Höhn, and Macpherson (1956, p. 116) distinguished them from the longspurs migrating through western Canadian provinces and Alaska. They related the birds from the latter localities to *C. l. alascensis*. These recent opinions continue the older views that the longspurs that migrate northward in spring through the western Mackenzie Valley to Alaska resemble those from Alaska and can be differentiated from the longspurs that nest on Greenland, Canadian Arctic Islands, on the mainland east of Mackenzie Bay, and in northern Eurasia.

## MIGRATION OF OTHER SPECIES IN YUKON TERRITORY

At Old Crow in the Porcupine Valley, migration carries several species that migrate along the Pacific Coast eastward, but no migration has been reported passing westward through the arctic part of Yukon Territory toward Alaska. I have reviewed evidence based upon dates of published reports from Alaska, Yukon, and British Columbia, which indicated that a number of American species of land birds migrate to Alaska through the watershed of the Yukon River in southwestern Yukon Territory (Irving, 1960a). While I was observing the migration of longspurs through southwestern Yukon during late April and early May in 1958, birds of the following species were also observed moving northward but not eastward: *Branta canadensis*, *Anser albifrons*, *Anas platyrhynchos*, *Anas acuta*, a few *Buteo lagopus*, a small number of *Circus cyaneus*, *Iridoprocne bicolor*, *Dendroica coronata*, *Euphagus carolinus*, and *Spizella arborea*. Only two species, *Bucephala islandica* and *Larus canus*, were observed flying southeastward along Teslin River, as if they had entered western Yukon Territory from eastern Alaska.

## DISCUSSION

A course of migration can be inferred from observations showing a common direction of flight over a significant portion of a migratory path. Directional flights have been watched in southwestern Yukon as they passed many points along a course westward for 260 kilometers (160 miles) between Johnson's Crossing and Haines Junction. Great numbers of longspurs were observed proceeding uniformly westward over the 80 kilometers (50 miles) south of this line to Atlin, B.C.

Directional flights have also been observed during several years at Anaktuvuk. I have watched flights moving northward at points covering about 65 kilometers (40 miles) in the narrow upper valley of the Anaktuvuk River. Since 1947 resident Eskimos have annually reported northward flights of longspurs in spring over their camps and hunting parties that were distributed through 130 kilometers (80 miles) of the upper valleys of the John and Anaktuvuk rivers. This northward migrating stream is only a few miles in width, but it has been observed to transport many flocks of longspurs northward. The Nunamiut have seen flights of longspurs passing northward while they were earlier living as nomadic family groups encamped in spring in various valleys of the Brooks Range between Howard Pass (longitude 158° W.) and the Itkillik Valley (longitude 150° W.). The same northward migration of longspurs was described to the present Nunamiut by their parents. Over courses extending from 80 to 160 kilometers (50 to 100 miles) northward and across 290 kilometers (175 miles) from east to west, a great migration of longspurs passes through the valleys of the central Brooks Range.

Geographical succession of dates of first-arriving migrants is also an indication of the course and progress of the van of migration. In Alaska north of the Alaska Range reports from 19 localities follow the average date of arrival of longspurs at Atlin. At 18 localities their arrival occurred at dates consistent with reasonable rates of flight from Atlin. Records for the significant 18 localities have been averaged in four series according to intervals of longitude in Table 1. The calculated speed to points between longitudes 134° and 145° is 62 kilometers per day; between 148° and 156°, 73 kilometers per day; 157° and 164°, 91 kilometers per day; and 166° and 171°, 124 kilometers per day. The speed of the van of migration increases westward.

The advance of migration over south-central Alaska and the Aleutian Islands exceeded the possibility of flight from Atlin. When I informed Dr. Axel Hemmingsen of the earliness of arrival of longspurs in south-central and southwestern Alaska, he brought to my attention the fact that migration of some species eastward and westward through Asia and Europe proceeds more rapidly than northward. He had indicated (1951) that the advance of a number of migrations in Asia proceeded northward about as the movement in spring of fixed daily amounts of incident solar radiation. This relation would be fulfilled by the simultaneous arrival of the migratory front of a species all along a given high latitude.

Recorded arrivals of longspurs in south-central and western Alaska are not simultaneous, but they do not show progression eastward or westward. These records are not only fewer than those in the north, but I know that several of them were made by traveling naturalists as they arrived at localities and first saw longspurs. The records from north of the Alaska Range were made by observers resident in those localities during the spring migration, and usually in villages where resident people attentively watch and discuss migration. I suspect that careful observation will provide even earlier records of longspurs arriving on south-central and southwestern Alaskan coasts.

Records from the Aleutian Islands are too early to indicate that migration reaches there by skirting the coast of the Bering Sea after crossing Bering Strait or Sea from the Chukchi Peninsula. Only the existence of *C. l. coloratus* west of the Aleutians is evidence against migration from Siberia through the Aleutians. Although the progression of arrivals in northern and western Alaska is consistent with migration through the headwater valleys of the Yukon, it is possible that some longspurs migrate from Siberia to Alaska. Four passerine species regularly migrate in that direction, but a larger number of species mi-

grate over the interior of America to reach eastern Siberia. In recent years we have had no view of the exchange between Asia and America at the northern point where they are so close geographically.

No doubt there are other localities than in Yukon Territory and the Brooks Range where migrating flocks of longspurs can be watched along courses long enough to define the direction of their migratory flights. By strategic selection of a few localities, a prearranged tactical scheme of observation may define the physical progress of migration in one year. In addition, the flocks can be characterized by ratios of sexes, social behavior, plumage, fatness, and condition of gonads. These characteristics can be used to distinguish the flocks and to demonstrate social and physiological factors that are causally related to the organization and progress of migration.

#### SUMMARY

Lapland Longspurs, ascribed to *Calcarius lapponicus alasensis* Ridgway, nest in great numbers over the arctic tundra and grassy land west of the forests of Alaska and over the Aleutian Islands. During 10 years great numbers of longspurs have been observed in May migrating north through Anaktuvuk Pass. Similar migrations proceed through other interior valleys of the Brooks Range, taking vast numbers of longspurs toward the arctic tundra. There is no evidence that this migration proceeds westward to Alaska through arctic Yukon Territory or eastward from Siberia.

In the last week of April and first of May 1958, great numbers of longspurs, in flocks at first containing mostly males, were seen migrating westward over a distance of 260 kilometers (160 miles) through the headwater valleys of the Yukon River in southwestern Yukon Territory. Longspurs reach northern and western localities north of the Alaska Range after their appearance in southwestern Yukon Territory at dates indicating plausible rates of migration from Yukon Territory through Alaska.

South of the Alaska Range and on the Aleutian Islands, arrivals are so early that these regions cannot be settled by the migrants observed in Yukon Territory. Unobserved flights coastwise or overwater are suggested.

The northward advance of the front of longspurs migrating through Alaska is slow, but it increases as the northward component of migration diminishes and as the westward component increases.

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TEMPERATURE REGULATION IN NESTING BONIN  
ISLAND PETRELS, WEDGE-TAILED SHEARWATERS,  
AND CHRISTMAS ISLAND SHEARWATERS

THOMAS R. HOWELL AND GEORGE A. BARTHOLOMEW

THIS paper represents part of a study on the thermoregulatory responses of nesting sea birds to natural environmental conditions. The investigations were conducted on Midway Island, a coral atoll located at latitude  $28^{\circ} 13' N.$  and longitude  $177^{\circ} 23' W.$  in the Leeward Chain of the Hawaiian Islands. A previous publication (Howell and Bartholomew, 1961) dealt with the two species of albatrosses that breed on Midway, and the present study concerns the other three procellariiform species that regularly nest on the island. Bailey (1956) has summarized much of the natural history information on the avifauna of Midway Island, and Farner and Serventy (1959) include references to most of the pertinent literature on thermoregulation in procellariiform birds.

## ENVIRONMENTAL CONDITIONS

Data from the Navy meteorological station show that the macroclimate of Midway Island is remarkably equable. In January and February, the mean low is  $15^{\circ} C$  and the mean high is  $21^{\circ} C$  (extremes,  $12^{\circ}$  to  $24.5^{\circ} C$ ). In June and July, the mean low is  $21^{\circ} C$  and the mean high is  $28.5^{\circ} C$  (extremes,  $18.5^{\circ}$  to  $31^{\circ} C$ ). However, these temperatures were taken at a height of 21 meters above ground; the microclimates to which the nesting birds are exposed are more variable and are discussed below in the accounts for each species.

## MATERIALS AND METHODS

All measurements were made on unconfined birds under natural conditions. Temperatures were measured by means of a portable, battery-powered, multichannel thermister thermometer manufactured by the Yellow Springs Instrument Company, Yellow Springs, Ohio. We used a variety of probes and leads that enabled us to measure temperatures with the sensing element as far as 20 meters from the indicating meter. All thermisters were calibrated with a Bureau of Standards thermometer. Temperatures were read to the nearest  $0.1^{\circ} C$ . By using several sensing elements in different channels of the instrument, we were able to obtain essentially simultaneous determinations of black-bulb, air, substratum, and body temperatures. Deep body (core) temperature was measured by gently inserting a steel-sheathed thermister





Figure 1. Bonin Island Petrel taken from its nesting burrow on Midway Island in January 1960. Note the distinctive underwing pattern.

probe down the esophagus to or into the stomach. Foot temperatures were obtained by enclosing a "banjo tip" surface-temperature-indicating thermister in a fold of the webbing. The same thermister was used in taking incubation patch temperatures by pressing the flat tip of the probe against the bare skin. Temperatures of eggs were obtained by slipping a vinyl-sheathed probe 3 mm. in diameter through a small hole bored in the shell; care was taken to place the thermister element in the approximate center of the egg.

The species studied can be seized when on land without much difficulty, and temperatures were recorded within 15 or 20 seconds after grasping the birds. It is highly improbable that any significant elevation of temperature due to struggle or excitement would occur in this brief interval.

*Pterodroma hypoleuca hypoleuca*

The form known as the Bonin Island Petrel (Figure 1) breeds in the Bonin Islands and the Leeward Chain of the Hawaiian Islands and ranges widely over the tropical and temperate parts of the Pacific. These petrels are probably the most abundant nesting species on Midway; they nest in burrows in the coral sand and are strictly nocturnal. They are found on Midway during fall, winter, and spring, but are scarce or completely absent during summer. Because they are nocturnal and nest in deep burrows, these birds are not exposed to the heat stress imposed on surface nesters. During January and February 1960 all of the burrows that we dug out contained single eggs, and one or both parents were in attendance.

Our observations on the temperatures of these birds are summarized in Table 1. The daytime temperatures were obtained by digging the petrels out of their burrows and taking measurements as soon as we could reach the birds. Nocturnal temperatures were obtained by picking up birds on the ground as they returned to their burrows after feeding at sea. Nocturnal body temperatures average 1.4° C higher

TABLE 1  
TEMPERATURES (°C) OF THE BONIN ISLAND PETREL

	Time	Mean	No. of birds	$\sigma$	Range	Air T.
Daytime	1345-1530	38.5	10	0.47	37.4-39.2	23.0-23.8 (in burrows)
Nighttime	2130-2206	39.9	10	0.51	39.1-41.0	22.5 (in open)



Figure 2. Wedge-tailed Shearwaters at a fully exposed surface nest on Midway Island, June 1959.

than the daytime temperatures, and the difference is statistically significant. In fact, there was practically no overlap between the maximum daytime (resting) temperature and the minimum nocturnal (active) temperature, although environmental temperatures were virtually the same under both circumstances.

*Puffinus pacificus*

This species breeds at many locations in the Indian and Pacific oceans within about 30° of the equator. On Midway it is abundant in spring and summer. Although at many localities within their range these shearwaters nest in burrows, on Midway they commonly nest in shallow depressions in the sand. The nest is usually in at least partial shade, but in rare instances nests were placed completely in the open (Figure 2). One egg constitutes the usual clutch, but occasionally we found a bird incubating two eggs. In mid-June 1959 these birds were in the early stages of incubation, for numerous eggs examined in connection with temperature measurements had no visible embryos and we found no nestlings. Both parents participate in incubation and both have an incubation patch; often both birds are present at the nest site.

Data on temperature of the environment, the internal temperature of brooded eggs, and temperatures of relevant parts of the body are summarized in Figure 3. Noteworthy points are as follows:

1. The mean diurnal body temperature (39.5° C) is significantly higher than the mean nocturnal body temperature (37.7° C).
2. Daytime incubation patch temperatures (mean 37.8° C) average 1.7° C lower than daytime body temperatures.
3. Internal egg temperatures (mean 34.3° C), although taken within 30 seconds after removal from under the incubating bird, average 3.5° C lower than incubation patch temperatures.
4. Eggs left exposed in full sun have internal temperatures (mean 40.2° C) that are essentially the same as that of the substratum and average over 6° C higher than the incubated eggs and 2.4° C above the incubation patch.
5. Foot temperatures (mean 33.6° C) average lower than egg temperatures and incubation patch temperatures but are higher than air temperature; foot temperatures are also highly variable.

The diurnal cycle of body temperature in this species is considered in the general discussion in comparison with other species. The difference between incubation patch temperature and internal egg temperature merits comment here. None of the eggs had visible embryos, and

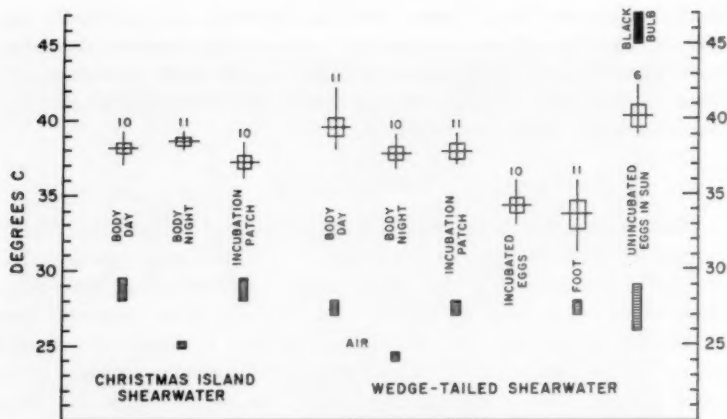


Figure 3. Summary of temperature data for Christmas Island and Wedge-tailed Shearwaters. Horizontal lines indicate the means (M); vertical lines indicate the range. Rectangles indicate the interval  $M \pm 2\sigma_M$  to  $M - 2\sigma_M$ . Numbers indicate the sample size. Cross-hatched symbols show the range of air temperatures during the period when body temperatures were being measured.

heat production within the egg must have been negligible. The internal egg temperature, then, presumably represents an equilibrium between the slightly warmer skin of the incubation patch and the cooler substratum. The range of variability of egg and incubation patch temperatures is almost identical, indicating the extent to which the patch controls the egg temperature.

We endeavored to obtain continuous figures on the incubation temperature by implanting a thermister probe inside an incubated egg and replacing it under the bird. The probe was flexible, and presumably its tip was located under the upper surface of the egg and thus very close to the incubation patch. A continuous record of incubation temperature for three hours varied only from 36 to 36.6° C, which is at the upper limit of the range of temperatures taken in the center of incubated eggs.

The moderate air temperature in the shade on Midway in the summer should present no heat stress for unbrooded eggs in sheltered locations. The relatively few shearwaters that nest in the open sun, however, face a formidable intensity of solar radiation as black bulb temperatures are often above 45° C. The parents at these nests left the eggs from midmorning to midafternoon, presumably because the

heat was too great for the birds. The egg temperatures reached levels that are known to be detrimental to development in other species (Baerends, 1959:357), and we doubt that these fully exposed shearwater nests were successful.

The Wedge-tailed Shearwater has pale foot webbing in which blood vessels are clearly visible, and we took foot temperatures to see if there was any indication that the vascular webbing contributed to the heat of incubation. The variability of foot temperature, and especially the low mean, shows that this is not the case.

We obtained weights of 19 eggs without visible embryos, and the weights proved quite variable. The range was 52-67 g., with a mean of  $59.5 \pm 4.2$  g.

#### *Puffinus nativitatis*

The Christmas Island Shearwater breeds on many Pacific islands within  $30^\circ$  of the equator. On Midway this species is less frequently seen in the daytime than the Wedge-tailed Shearwater, but at dusk and at night the two forms appear to be equally numerous. Nests of *P. nativitatis* were usually shallow depressions in the sand in *Scaveola* thickets, but the nests tended to be farther inside the thickets and in deeper shade than those of *P. pacificus*. Most of the nests that we found contained single eggs, but two nests had recently hatched young. Adults of both sexes have an incubation patch, and both were often present together at the nest.

Data on body and incubation patch temperatures are summarized in Figure 3. Noteworthy points are as follows:

1. There is no significant difference between diurnal (mean  $38.1^\circ\text{C}$ ) and nocturnal (mean  $38.6^\circ\text{C}$ ) body temperatures, although the latter average slightly higher.
2. Under a given set of conditions, body temperatures are strikingly uniform.
3. Daytime incubation patch temperatures (mean  $37.2^\circ\text{C}$ ) average almost  $1^\circ\text{C}$  lower than daytime body temperatures.

The only two nestlings that we found were discovered on 20 June. One had just hatched, and the other was a 61-g. chick that was being closely brooded. Both were covered with sooty black down. On 22 June their weights were, respectively, 40 g. and 84 g. They were taken from under the brooding parents on that day and placed in the open in direct sunlight; the results are shown in Figure 4. Both the nestlings began to pant within 10 minutes of the start of their exposure. The temperature of the younger chick rose steadily, and the bird died

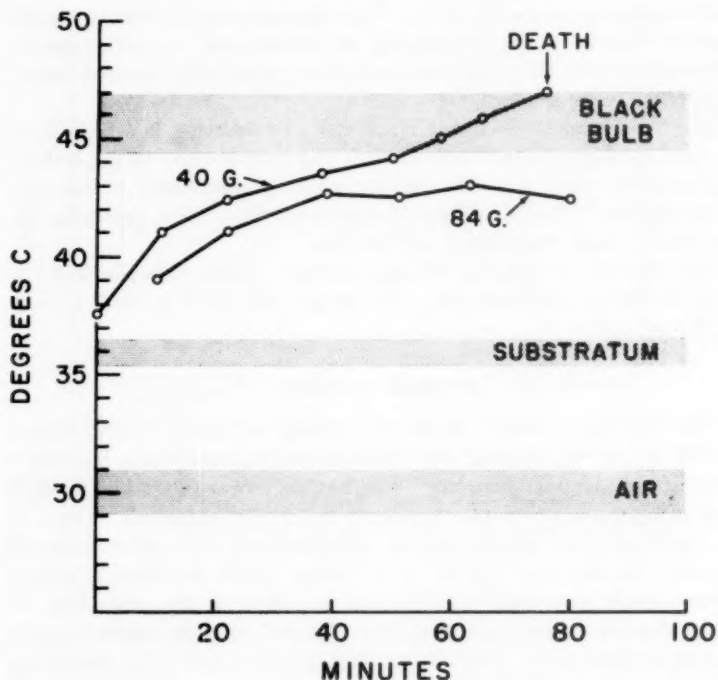


Figure 4. The course of body temperature of two downy nestlings of the Christmas Island Shearwater removed from the nests and placed in direct sun.

at a body temperature of 47° C. The dead nestling was left in the sun; after 50 minutes the body temperature was 44° C—essentially the same as the black bulb temperature at the time the measurement was made. The body temperature of the older nestling rose initially and then stabilized between 42 and 43° C; the bird remained in excellent condition to the end of the experiment. It was returned to its nest, and when examined on subsequent days it appeared to be in good health and to be growing well.

#### DISCUSSION

It was not possible to distinguish externally between the sexes of the three procellariids that we studied. In each species both sexes have incubation patches and appear to participate in nest activities. We



assume that in these species as in *P. tenuirostris* (Farner and Serventy, 1959) there is no sexual difference in body temperature.

*Daily temperature cycles.* Farner (1956) has shown that in a southern hemisphere procellariid, the Fairy Prion (*Pachyptila turtur*), body temperatures of active birds on the ground at night average about 1.3° C higher than those of birds incubating in burrows during the day. Our data for the Bonin Island Petrel show a similar situation; body temperatures of birds active on the ground at night averaged 1.4° C higher than those of incubating birds in burrows during the day. The mean body temperature of incubating Bonin Island Petrels (38.5° C) is almost identical to that of the Fairy Prion (38.6° C) but considerably higher than the mean of 37.2° C reported by Folk (1951) for incubating Leach's Petrels, *Oceanodroma leucorhoa* (Hydrobatidae). Environmental temperatures were about 23° C for the Bonin Island Petrel and 11.6° C for Leach's Petrel; Farner did not indicate environmental temperatures in his study.

Although not as strictly nocturnal as the Bonin Island Petrel, the Christmas Island Shearwater is primarily active at night during the nesting season. The nocturnal body temperatures of this species averaged slightly but not significantly higher than those recorded during the day. The absence of a significant difference probably has several causes. The surface-nesting habits expose the birds to higher air temperatures during the day than would be encountered in burrows; the lack of air movement in the dense *Scaveola* thickets allows air temperature at the nests to reach almost 30° C. The nests are located in the midst of a dense population of active, vocalizing birds of a number of species; this probably keeps the incubating shearwaters more alert than if they nested in burrows, and consequently may contribute to the relatively high level of daytime body temperature. Moreover, the Christmas Island Shearwaters that we studied had lower nighttime temperatures than have been reported for other shearwaters nesting at higher latitudes. For example, the maximum body temperatures (39.3° C) of active *P. nativitatis* caught on the ground at night are not as high as even the mean nocturnal body temperatures (39.9° C) of *Puffinus tenuirostris* measured under similar conditions (Farner and Serventy, 1959). About half of the Christmas Island Shearwaters captured on the ground at night must have recently come in from the sea as they vomited fresh squid when handled, yet these active birds had temperatures in the same range as those sitting quietly on shaded nests during the day. Thus, unexpectedly high daytime body temperatures for the incubating birds overlapped unexpectedly low nighttime temperatures

of the active birds and eliminated any evidence of a clear-cut daily temperature cycle.

Nesting Wedge-tailed Shearwaters are more active during the day than nesting *P. nativitatis*, but they are still primarily nocturnal. Nevertheless, our data on this species at Midway Island show that daytime body temperatures of incubating birds average significantly higher than those of active birds at night. The causes of this situation are probably similar to those outlined above for *P. nativitatis*, but accentuated. Many nests of the Wedge-tailed Shearwaters are in only partial shade, and solar heat undoubtedly augments the effect of high air temperatures on the body temperatures of incubating birds in the daytime. The body temperatures of four birds incubating in partial sun averaged 40.3° C (39.3-42.1); these figures include the highest temperatures we recorded for this species and account in part for the high mean daytime body temperature.

Farner and Serventy (1959) reported a mean body temperature of 38° C for *P. tenuirostris* incubating in burrows at air temperatures of about 22° C. Bartholomew obtained data on the similarly sized sub-tropical species, *Puffinus puffinus opisthomelas*, on Guadalupe Island, Baja California, Mexico, on 19 April, 1956. These shearwaters were incubating deep in burrows where the air temperature was 21-21.9° C; the body temperatures of four birds averaged 37° C (36.8-37.2). Thus, the mean daytime body temperatures of both *P. tenuirostris* and *P. puffinus* are lower than the daytime mean (39.5° C) for the surface-nesting *P. pacificus* on Midway.

*Nesting temperatures.* Farner and Serventy (1959) have pointed out that at burrow temperatures of about 22° C, one- and two-day-old chicks of *Puffinus tenuirostris* have sufficient thermoregulatory ability to keep body temperatures up to the typical adult level. Although our data on thermoregulation in nestlings of *P. nativitatis* are limited, it is apparent that young chicks of this species are unable to keep body temperatures down to the typical adult range when exposed to direct solar radiation and moderately high air and soil temperatures (Figure 4). Surface nests of the Christmas Island Shearwater on Midway were always in deep shade, and the attentive parents brooded the nestlings continuously during the day. It is not surprising, in view of the nesting habits of these and most other shearwaters, that thermoregulation of the young under cool conditions is more effective than it is under heat stress.

## ACKNOWLEDGMENTS

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## SUMMARY

Thermoregulation was studied in three species of procellarids nesting on Midway Island. The Bonin Island Petrel (*Pterodroma hypoleuca hypoleuca*), a nocturnal species that nests in burrows, shows a significantly higher mean body temperature when active at night than when incubating during the day ( $39.1^{\circ}\text{C}$  as opposed to  $37.4^{\circ}\text{C}$ ). The Wedge-tailed Shearwater (*Puffinus pacificus*), a partly nocturnal species that is primarily a surface nester on Midway, shows a mean daytime body temperature ( $39.5^{\circ}\text{C}$ ) that is significantly higher than the mean nighttime body temperature ( $37.7^{\circ}\text{C}$ ). Measurements of egg, incubation patch, and foot temperatures show that the temperatures of incubated eggs without visible embryos average  $3.5^{\circ}\text{C}$  lower than incubation patch temperatures (mean  $37.8^{\circ}\text{C}$ ) and that the feet do not contribute to the heat of incubation. The Christmas Island Shearwater (*Puffinus nativitatis*) has habits similar to those of *P. pacificus* but is more nocturnal and locates its surface nests in deeper shade. Daytime (mean  $38.1^{\circ}\text{C}$ ), and nighttime (mean  $38.6^{\circ}\text{C}$ ) body temperatures of adults do not differ significantly. A two-day-old nestling could not tolerate long exposure to intense solar heat, but an older downy chick regulated body temperature at an elevated but sublethal level ( $42\text{--}43^{\circ}\text{C}$ ) under the same conditions. Ecological implications of the data on all three species are discussed.

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# SALIVARY GLANDS IN THE GRAY JAYS (*PERISOREUS*)

WALTER J. BOCK

UNIQUE morphologic specialization in a single species or genus provides one of the best approaches into the entire subject of adaptation and the evolution of new groups. Further, if the animal possessing the unique specialization lives in an unusual or strenuous habitat, then the action of the evolutionary processes is frequently easier to understand. The gray jays of the genus *Perisoreus* form an excellent basis for the discussion of some of these problems as they are permanent residents in the far northern coniferous forests—one of the most strenuous habitats available to passerine birds. Gray jays must possess adaptations to the cold of winter and the ability to utilize the limited food supply available during the winter. The question of protection against the cold shall not be considered as I wish to concentrate on the problem of food gathering. This latter problem has been overlooked by ornithologists because the gray jays, like most other permanent residents in the northern forests, were not known to have any marked feeding adaptations. But the discovery of a pair of "woodpecker-sized" mandibular mucous glands in the gray jays reopens the question of their feeding habits. Mucous glands as large as those found in the woodpeckers are, to the best of my knowledge, not known in any other passerine bird. This leads to the question of whether this structure is a special adaptation in the gray jays for life in the northern coniferous forests. These questions cannot be answered directly because of a lack of information on the function and biological role of the glands, but I shall speculate on them because of their bearing on the general topic of adaptation of birds to the northern forests as well as their importance to the evolution of the gray jays.

## DESCRIPTION OF THE GLAND

The pair of mandibular glands was present and equally well developed in the three adult specimens of *P. canadensis* examined, indicating that they are a normal feature of this species. The glands were also present in the two specimens of *P. infaustus* dissected, but they were considerably shrunken because of preservation and long storage in alcohol. Whether the glands are present in the third species of this genus, *internigrans*, is not known. Topographically, the glands lie in the same position and have the same general appearance as do the mucous glands of the woodpeckers. When the head is examined from beneath, the paired mandibular glands can be seen lying between the mandible and

the hyoid bones (Figure 1B). At their anterior end, a small, flattened medial projection may be seen. This flattened appendix extends somewhat forward of the main portion of the gland and disappears into the floor of the mouth lateral to the tongue at a point just level with the center of the eye. The main collecting ducts, which lie within this

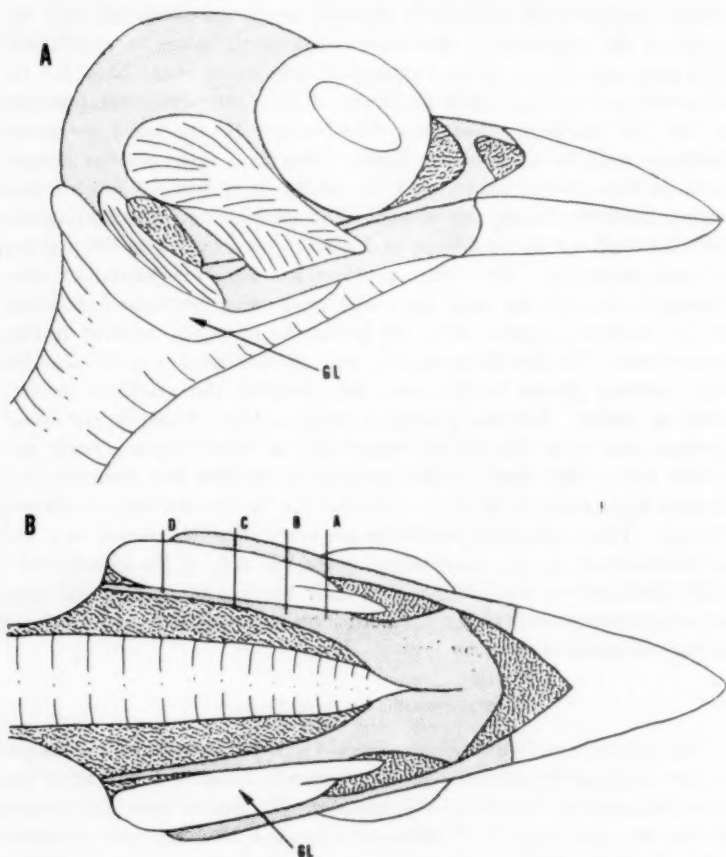


Figure 1. The mandibular gland of the Gray Jay (*Perisoreus canadensis*) seen from the side (A) and from beneath (B). The gland (GL) lies between the mandible and the hyoid bones and extends around the back of the skull to reach a point just dorsal to the origin of the *M. depressor mandibulae*. The lines crossing the gland in the ventral view indicate the levels at which histological sections were cut.

medial projection, as will be shown below, pass through the floor of the mouth to open into the buccal cavity near the lateral edge of the tongue. When viewed from the side (Figure 1A), the gland can be seen curving dorsally around the posterior end of the mandible to reach a point just above the dorsal end of the *M. depressor mandibulae*. When removed from the head, this "moon-shaped" gland is seen to be twisted on its longitudinal axis so that its posterior end no longer faces dorsally, but somewhat medially. As would be expected, the general shape of the gland conforms to the shape of the head—that is, it fits in between the other structures without interfering structurally or functionally with them (see Dullemeijer, 1958, pp. 77-78). In size, the gland is approximately 24 mm. long, 6 mm. wide at its greatest width and 4 mm. thick (maximum).

According to the most recent classification for the avian salivary glands (Antony, 1920; see also Farner, 1960, pp. 413-414), the enlarged gland in the Gray Jay is part of the *Gl. mandibularis*. Most probably it is the *Gl. mandibularis medialis*, although it is difficult to distinguish and identify the various components of the *Gl. mandibularis* complex with certainty. It should be pointed out that the *Gl. mandibularis medialis* of the Gray Jay is almost certainly not homologous with the large mucus-secreting gland in the woodpeckers. Unfortunately, Antony was not clear in her discussions of the "woodpecker gland." In her listing of the salivary glands in birds (p. 550), she considers the "woodpecker gland" to be a completely separate gland, the *Gl. picorum*; but in a table showing the distribution of the salivary glands in the woodpeckers, she includes the *Gl. picorum* as a subdivision of the *Gl. mandibularis*. Thus, it is not certain whether the *Gl. picorum* is part of the *Gl. mandibularis* complex; but, even if it is, it would be an anterior part of that gland, not a medial and more posterior part as is the mandibular gland of the gray jays.

The gross histologic structure of the mandibular gland can be understood by an examination of the figures (see Figures 2A-2D). The collecting ducts gather together on the medial side of the gland, forming the flattened appendix seen in the ventral view of the head. In the anterior sections, the collecting ducts comprise more than half of the cross-sectional area, while in the posterior slides, the ducts become smaller, pass to the internal surface of the gland, and gradually drop out with a corresponding disappearance of the medial appendix. The epithelial cells lining the collecting ducts appear to be a pseudostratified columnar type with a striated border. The secretory cells are arranged in long tubules, which run parallel to the longitudinal axis of the gland. A heavy theca of connective tissue surrounds each tubule as well as the entire gland. In the posterior half of the gland only secretory tubules are present; the collecting ducts have dropped out completely. Lumina and small ducts can be seen inside the tubules. The



secretory cells appear to be arranged in rows radiating out from the central duct of each tubule. The cells are relatively tall for secretory cells, with rounded nuclei that lie at the basal end of the cell, but are not pressed against the floor as is usual for mucus-secreting cells. These observations on the cellular structure are not conclusive because of the fixation, nor could any additional details be ascertained. It was not possible to determine the type of secretion from a histological examination of the gland cells.

The suspected mucus-secreting nature of the gland was confirmed by the application of several histochemical procedures (see Gomori, 1952, and Lillie, 1954, for description of these tests). Staining with Paraldehyde Schiff reagent (PAS), with PAS combined with a diastase digestion, and with toluidine blue were all positive, which proves quite conclusively that the granules within the secretory cells are mucoid and hence that this gland secretes mucus.

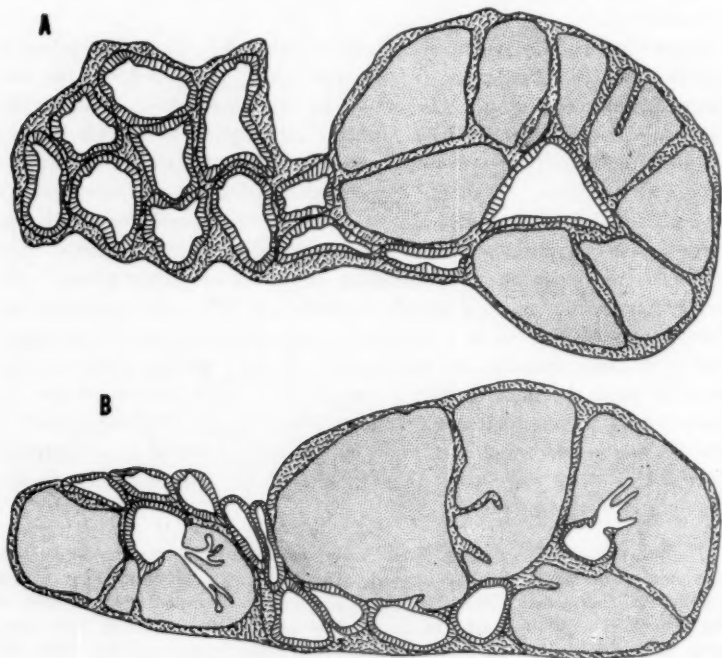
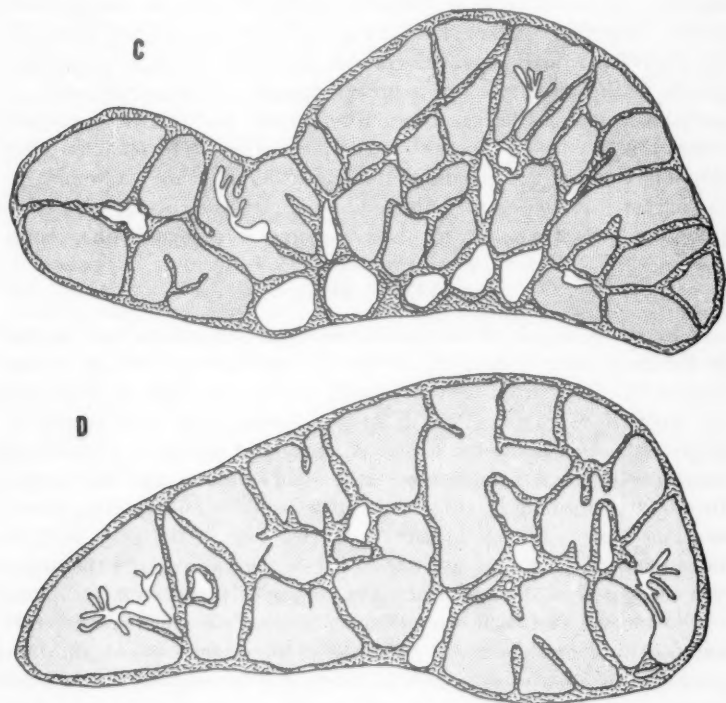


Figure 2. Semischematic drawings of the histological structure of the mandibular gland of the Gray Jay (*Perisoreus canadensis*). The Figures A to D were traced from sections cut from the levels A to D shown in Figure 1B. The sections are oriented with their ventral side upwards and their medial side to the left. Magnification of the sections is, for technical reasons, not the same; Figures A and B are enlarged about two to three times more than Figures C and D. The secretory tubules are shaded by stippling, the

## MANDIBULAR GLANDS IN OTHER CORVIDS

Before it is possible to inquire into the adaptive value of the large mandibular glands in the gray jays, it is necessary to ascertain whether this structure is unique in this genus. Specimens of the following forms were dissected: *Garrulus glandarius*, *Cyanocitta cristata*, *C. stelleri*, *C. coerulescens*, *Pica pica*, *Nucifraga columbiana*, *Corvus brachyrhynchos*, *C. corona*, and *C. frugilegus*. All had an area of small mandibular glands lying in the floor of the mouth as described for various members of this family (see, Cholodkowsky, 1892; Hölting, 1912; Greschik,



connective tissue by a broken-line pattern, and the collecting ducts are left blank with their walls shown by vertical lines in Figures A and B. In Figure A, the collecting ducts are bunched together on the medial side of the section; this is the medial projection seen in Figure 1B. Note how the collecting ducts then pass to the middle of the dorsal side of the gland (Figures B and C) before becoming completely scattered in the posterior part of the gland (Figure D).

1913; and Antony, 1920). Although this area is extensive in some species, no species have a gland equal in size to that found in the gray jays. Special care was taken in dissecting the rook because Antony (1920, p. 600) reported the *Gl. mandibularis externa* in this species to be 30 mm. long and 6 mm. wide. I dissected several adult rooks and found the *Gl. mandibularis externa* as well as the usual field of small mandibular glands. The *Gl. mandibularis externa* is buried within the floor of the mouth and is hidden for most of its length by the mandible. This gland appeared to be smaller than the figures given by Antony (precise measurements were not possible), but in any case it is considerably smaller in absolute and relative size than the mandibular gland of the Gray Jay. Although I was not able to examine all genera of the Corvidae, it may be tentatively concluded that the large mandibular glands in the gray jays are a unique feature in the corvids and are probably unique in the passerine birds. Additional evidence is needed before this conclusion can be fully accepted; this can be obtained while skinning birds as the glands lie directly under the skin. I would like to suggest that collectors examine all specimens of corvids, and other passerine birds if possible, for the presence of large mandibular glands.

#### DISCUSSION

Why should a pair of woodpecker-sized mucous glands have evolved in the gray jays, birds living in the far northern coniferous forests? Normally, mucus from salivary glands has the function of lubricating the mouth (see Farner, 1960, p. 414). Among birds with greatly enlarged salivary glands, the mucus is sticky and serves as a cementing substance for nest construction (*e.g.*, swifts) or to coat the tongue, thereby transforming it into a "lime-stick" suitable for capturing insects or other food (*e.g.*, woodpeckers). In the case of the gray jays, the most reasonable working hypothesis is that the mucus coats the tongue and changes it into a lime-stick. The tongue of these birds is a normal corvid tongue—flat with some fringing at the tip—which is completely suitable for tongue probing. The use of the tongue would allow the gray jays to obtain food such as seeds still in coniferous cones and insects in bark crevices, which they could not reach with their short, blunt bill. But do the gray jays obtain food by tongue-probing and if so, why?

A search was made through the literature to ascertain whether gray jays have been observed feeding by means of tongue probing. However, aside from numerous statements on the camp-robbing habits of these birds, I have found little about the food habits and feeding methods of the gray jays and nothing of help for

the present problem. Here I wish to enter a plea for observations on their feeding methods, especially during the winter when food would be scarce. These observations would be difficult to make because of the rarity of these birds and the fact that they can be shy and elusive during parts of the year, but this information is absolutely essential for solving the function of the mandibular glands. Perhaps the observations could be made on captive birds by presenting them with food (*e.g.*, coniferous cones containing seeds) that they can only reach with their tongues. Nevertheless, there is some indirect evidence supporting the hypothesis of tongue probing. First is the availability of food to the gray jays during the winter; the food supply, not the cold, is the more restricting factor to birds in the north. While the ground is covered with snow, the food supply is almost entirely restricted to what can be found on trees. And this food is most probably largely limited to what is concealed in crevices in the bark and so forth; any insects, their eggs, and so forth lying on exposed surfaces would probably be rapidly washed away by storms or may be too small to be utilized by gray jays. Besides insects in bark crevices, this food would include seeds still in coniferous cones. Second, the bill of these birds is blunt and would not permit them to obtain this food directly. Third, there are indications that the gray jays do eat pine seeds. Peterson, *et al.* (1954, p. 204) make the brief statement that the Siberian Jay is: "Agile in clinging to tips of pine branches to reach cones," which I was able to confirm in some observations on this species in northern Sweden during the summer of 1960. I saw several individuals of Siberian Jays clinging to the tips of branches and seemingly feeding on the cones hanging there, but I was not close enough to determine whether they were using their tongue in any way. Mrs. Lawrence informed me in a letter that during the winters when evergreen seeds are scarce, Gray Jays appeared at feeding stations in Ontario in greater numbers, which lead her to suspect that cone seeds may contribute an important part of the diet of these jays. She added that, unfortunately, she has never observed them eating seeds from cones. Mr. Helminen informed me, also by letter, that there are scattered reports of Siberian Jays in Finland eating coniferous seeds or cones during the winter, but he was not able to supply any further details. These few facts constitute all of the support for the tongue-probing theory, which must remain as a hypothesis until more evidence has been gathered.

It is, nevertheless, of interest to speculate further on the part played by the mandibular glands in the adaptation and evolution of the gray jays for which I shall assume the correctness of the tongue-probing hypothesis. Next it is important to know what percentage of their total food is obtained in this manner. It may be assumed that, during the summer months, only a small part of the food is attained by probing, while, during the winter, a major share of the total food is obtained by tongue probing. Again, these assumptions must be verified or rejected by direct observations, but until definite evidence is available, I shall accept them as tentatively correct. Hence, it may be concluded that, in addition to other necessary adaptations such as resistance to cold, the gray jays are able to live permanently in the northern forests because of their ability to gather food by tongue probing. Further, it may be

concluded that these anatomical features that enable the gray jays to tongue probe constitute the most important feeding adaptations of this genus. The mandibular glands are one of these important feeding adaptations, and probably they are the most basic one. All of the other anatomical features—the tongue, hyoid muscles, and so forth—involved in tongue probing are little, if any, changed from the typical corvid condition and may be considered to have been preadapted for the new feeding method. Only the mandibular glands are vastly different between the gray jays and other corvids, and they are the sole anatomical feature (*i.e.*, a mucus-secreting salivary gland) whose development determines whether a corvid bird can probe with a sticky tongue. Thus, the development of the mandibular glands was the critical morphologic innovation in the strictest sense of the concept (see Miller, 1949) that enabled the gray jays to enter their present ecological niche. One of the most interesting aspects of the mandibular glands as a critical innovation is that they are not a new structure, but only the enlargement and modification of a structure already present in the Corvidae. The enlargement of a gland is a rather simple evolutionary change, which shows how a simple modification can become the critical innovation permitting the development of a new feeding method and the utilization of a new ecological habitat, and might even have been the factor responsible for the evolution of a new genus of corvid birds.

The evolution of the large mandibular glands and the establishment of the gray jays as permanent residents in the northern forests can be easily visualized. The ancestral form may have had a distribution such as found in some present-day jays (*e.g.*, *Cyanocitta* or *Garrulus*)—covering the temperate and northern forests with the birds breeding in the northern parts of the range migrating to the southern parts—or they may have been temperate forest birds expanding to the north. These birds would have had the normal corvid arrangement and development of salivary glands, and most likely made no special use of their tongue in feeding. Yet, the tongue was probably slightly sticky because of the normal supply of mucus to the mouth. Two associated changes, one behavioral and the other morphologic, had to occur before the evolution of the large mandibular glands could begin; both of these changes are well within the normal range of reaction or variation of corvid birds. The behavioral change was that the birds began to probe into crevices with their tongue to reach the food lodged there, this action being well within the ability of these normally curious birds. The success of this new feeding action would depend upon the stickiness of the tongue. The morphologic change was an increase in the size of the mucous glands and hence the supply of mucus; however, it did not matter which of the salivary glands increased in size. The new, but inefficient, tongue-probing method allowed the birds to utilize a previously unattainable food supply and may have permitted them to remain longer in the northern parts of their range before moving south with the onslaught of winter. If it was advantageous for the birds to remain north

longer in the fall, then the new feeding method would have a definite selective value and those birds able to probe with their tongue would have a selective advantage. Why the new feeding method was advantageous—whether there was competition from other species in the temperate regions or whether the birds breeding early in the spring left more offspring—is of no importance; it is only necessary to assume that remaining in the northern part of the range was advantageous. At first only a part of the population would possess the beginnings of the new feeding method, and these would have been able to remain in the northern area slightly longer in the fall. As the genetic factors controlling the increase in the size of the mucous glands and the ability of probing with the tongue increased in the population, the efficiency of the tongue probing increased and the birds were able to remain in the north longer and longer in the fall until finally some individuals, by virtue of their now better-developed ability to tongue probe, were able to remain during mild winters. Specialization of tongue probing, including the size of the mucous glands, has reached the point that today the gray jays must move south only during the severest winters. From this suggested evolutionary history, it can be seen that the behavioral and morphologic changes occurred simultaneously and slowly during the entire phylogeny of the gray jays, and that even the very first changes were under the control of natural selection.

It may be asked: if the large mucus-secreting mandibular glands are essential adaptations in the gray jays, why have similar glands not developed in other permanent residents of the northern forests? The answer may lie in the fact that the feeding methods of the ancestors of most of these birds were suitable, *i.e.*, preadapted, to life in these forests and did not have to be altered as the birds entered the new habitat. Woodpeckers, nuthatches, chickadees, finches, shrikes, and so forth all feed on food that is available in the northern forests during the winter, so that these birds can become permanent residents if they are able to resist the cold. Moreover, it is possible that some of these birds have special feeding adaptations that are yet unknown.<sup>1</sup> But the most interesting fact is that *Perisoreus* is, with the exception of *Pinicola*, which has doubtless evolved from a northern-adapted finch, the only genus of passerine birds endemic to the northern coniferous forests; all other permanent residents of these forests are members of widespread genera. This may be coupled with the fact that the gray jays are the only known passerine birds with a special feeding adaptation to this habitat. This may be only a coincidence. But in any case this correlation deserves additional study.

<sup>1</sup> Tichomirov (1925) has reported "larger" mandibular glands (= *Gl. mandibularis externa*?) in some species of chickadees. From his figures this gland appeared to be as large, relatively, as the *Gl. mandibularis externa* of the rook, and hence it is considerably smaller, relatively, than the mandibular gland of the gray jays. It has been noted by some observers that the gray jays feed in a manner similar to chickadees. These observations allow two assumptions. The first is that chickadees can also tongue probe. The second is that the mucus from the large mandibular glands in one or both forms has a totally different function.



## ACKNOWLEDGMENTS

I am indebted to Dr. Carl Helms, who collected the specimens of Gray Jays (*Perisoreus canadensis*) used in this study, to Dr. Ruth Willey, who stained the slides for the presence of mucus and interpreted the results, to Dr. P. Dullemeijer (University of Leiden), who supplied several specimens of the Rook (*Corvus frugilegus*), to the officials of the British Museum (Natural History), who gave permission for dissecting two specimens of the Siberian Jay (*P. infaustus*), and to my wife, Kitty, who prepared the histological slides as well as aiding in the preparation of the manuscript and figures. My sincere thanks are extended to all. In addition I wish to thank the many people, especially Mrs. L. de K. Lawrence and Mr. Matti Helminen, who have supplied information on the feeding habits of the gray jays. This study was started while I was working under a National Science Foundation predoctoral fellowship at Harvard University and completed while I was at the Anatomisches Institut der Universität, Frankfurt a. M. under a National Science Foundation Postdoctoral Fellowship. I wish to express my gratitude to both the National Science Foundation and to the officials of the respective institutes for their generous support and help.

## SUMMARY

A pair of woodpecker-sized, mucus-secreting mandibular glands has been found in the gray jays; these are a unique feature in the Corvidae and are probably unique in the passerines. The mucus from these glands presumably coats the tongue, thereby making it sticky and suitable for probing into crevices for insects and under the scales of cones for seeds during the winter when other food is scarce. The mandibular glands are thus probably the basic feeding adaptation in these species and appear to be the critical innovation that has allowed the development of a new method of feeding and the invasion of a new ecological niche.

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AGGRESSIVE NEGLECT AS A FACTOR IN INTERSPECIFIC  
COMPETITION IN BIRDS

S. DILLON RIPLEY

IN their comments on an earlier paper of mine (1959), on the subject of competition between species in the Moluccan Islands, Hutchinson and MacArthur (1959) coined the phrase *aggressive neglect* to describe the tendency of one species to neglect its nest or young owing to the release of excessive aggressive behavior in the presence of a second species. This aggressive behavior with consequent limiting of the reproductive rate has been suggested by myself (*t.c.*) as possibly having survival value in cases of interspecific competition.

According to the Volterra-Gause principle, two species may not occupy identical niches. And yet under certain circumstances, such as the case of the Asian-derived sunbirds and the Australian-derived honeyeaters in the Moluccan and New Guinea islands, it appears as if these species were in competition, not complete, in the absolute sense, but to a degree where the presence of one appears to affect the other. One evidence of this is the fact that on small islands throughout the area one species or the other may occur but not both. Thus in such confined situations where the total available biotope is highly compressed, competition has gone in favor of *Nectarinia*, the sunbirds, or *Myzomela*, the honeyeaters (see Figure 1).

On larger islands such as on Batjan in the Moluccas where I made my study,<sup>1</sup> small habitat preferences in addition to behavioral differences may then allow these species to co-occur. In this connection additional observations may be of interest. Both on Batjan and on Halmahera Island I observed an Asian-derived species, a moderate-sized, olive-yellow-colored bulbul, *Hypsipetes affinis*. This bulbul, which seems closely allied to species found in Sanghir and the southern Philippine Islands to the northwest, was found by us in small parties in a variety of habitats varying from cut-over scrub and garden patches to heavy evergreen forest, ranging from sea level up to at least 3,300 meters. In our experience the species showed no special habitat preference, being found indiscriminately on the edges of human habitation or in undisturbed forest. Birds in breeding condition tended to be in pairs and presumably held territories, although I was unable to determine the size or composition of these. Out of the breeding season, groups or small flocks, perhaps family parties, numbering up to eight individuals or more, were found in the forest, occasionally attracting other species such as

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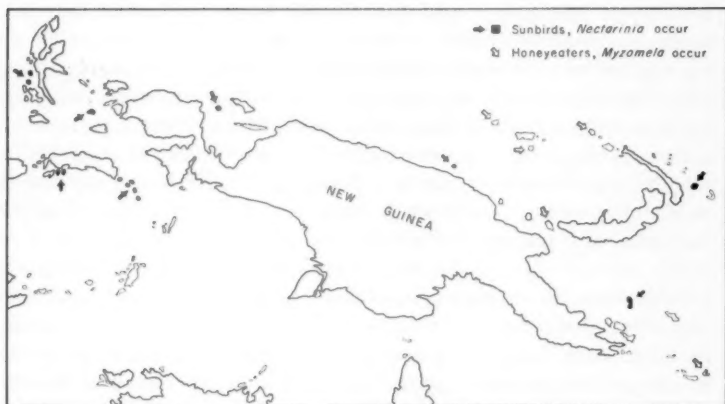


Figure 1. Small islands in the New Guinea area on which, so far as is known, only sunbirds or honeyeaters occur.

monarch flycatchers into the group in one of those typical mixed feeding flock associations. These birds primarily feed on insects, often visiting the corollas of flowers in bloom in the trees. Small fruits on vines or trees in the forest are also eaten. *Hypsipetes* has a fairly long history in the Moluccas, having been divided into several recognized local populations or subspecies.

A large honeyeater, *Melitograis gilolensis*, also occurs on Halmahera and Batjan and is closely comparable in size to the bulbul. This honeyeater occurs from sea level up to at least 1,600 meters altitude. As far as could be observed, the honeyeater also primarily feeds on insects, usually those attracted to flowering or fruiting trees, but also feeds on nectar as well as small fruits. Thus both species tend to feed on similar types of food, with the honeyeater having a greater predilection for nectar, and the bulbul a greater predilection for small fruits. The bulbul, however, will take nectar of flowers that are accessible in size, thus indicating that the mode of life of these two very divergent species is closely similar. *Melitograis* is presumably of considerable age, being an endemic genus of the archipelago.

From the observations made on Halmahera and Batjan, it would appear that in this case, as in that of the sunbirds and the smaller honeyeater referred to earlier (*t.c.*), the species are to a very considerable extent in competition, and that whereas the bulbul is numerous, the large honeyeater, *Melitograis*, is uncommonly encountered. Although we saw the bulbuls frequently, usually in pairs or small parties, we observed

*Melitograis* infrequently and then always single individuals only even during the breeding season. Presumably *Melitograis* ranges widely and has a scattered population. Furthermore, it appears to be highly aggressive. On one occasion, on Halmahera, I observed a single honeyeater fly assertively at a small flock of bulbuls, chasing them vigorously and dispersing the group in every direction. On another occasion, on Batjan, a single large honeyeater was in a flowering tree, *Erythrina* sp., near the shore. It continually darted actively out at other birds when they attempted to come into the tree to feed. This tree, which was in full flower, had a rather small canopy not more than 6 meters across. Perhaps the area was sufficiently constricted to be incompressible in the eyes of the honeyeater, so that it quickly attained a threshold of intolerance. In other cases smaller species like the small honeyeater, *Meliphaga*, flower-peckers, *Dicaeum*, sunbirds, *Nectarinia* and even leaf-warblers, *Phylloscopus*, had all been observed in the crown of the flowering *Albizia* trees, albeit there was much "chasing" going on. But, of course, the crown of these trees is very large indeed, 25 or 30 meters across.

These observations, however, would indicate that the wide-ranging, larger honeyeater, which appears to be to a considerable extent in competition with the common and widespread bulbul, is aggressive and is locally dominant. Here again perhaps is a case of aggression playing a part in interspecific relations that may serve as a type of density-dependent phenomenon effective in regulating abundance and thus reducing competition.

#### OTHER POSSIBLE EXAMPLES

Another island group in which species of widely differing origin have come into contact is the Hawaiian Archipelago, where both the Drepanidae of New World origin and the Meliphagidae of the Australian region occur. Scott Wilson (1890-1899) speaks of the large honeyeater, *Moho nobilis*, the "O-O" of the Hawaiians, as being noted for its pugnacity toward its "arch rival," *Vestiaria coccinea*, the "Iiwi," a New World honey-sucker. So noted was this antagonism that bird trappers for the old royal family would snare an "Iiwi," place it on a branch with bird lime all about, and thus catch the "O-O" as it dove down to the attack. Both genera fed on the flowers of the lobelias native to the Islands, such as the ohia or the tree-lobelia. *Moho* appears always to have been a bird of some rarity in the Hawaiian Islands, aside from the fact that its feathers were used in feather cloaks. In any case it is perhaps significant that the scarlet Iiwi, *Vestiaria*, was also in demand and under human predation, and yet is still relatively common today, while

*Moho* has become extinct on Hawaii, Oahu, and Molokai. That interspecific competition has played a part in the unequal population ratio of these species and their subsequent histories is perhaps confirmed by the additional statement of Perkins (1903) that on Kauai the local species of *Moho*, *braccatus*, had somewhat changed its feeding habits and was eating insects as well as wild bananas, and had adopted more creeperlike habits. Kauai is, of course, a relatively small island with a considerably compressed biotope compared with the larger island, and thus species of similar habit might tend to evolve new feeding adaptations under conditions of enhanced competition.

I have already mentioned other examples of possible aggressive neglect as described in the literature (Hagen, 1947; Pitelka, 1951). It is possible that detailed observations of the interrelationships between *Neodrepanis*, the wattled "sunbird" [a member of the *Philepittidae*, as pointed out by Amadon (1951)], and *Nectarinia notata*, the green sunbird on Madagascar, would prove of interest in this connection. Rand (1936) notes that both species fed in certain forest trees in the humid forest zone, whose flowers had very long corollas. Observations indicate that *Neodrepanis* is local and uncommon, while *Nectarinia* is prevalent.

#### INTERSPECIFIC TERRITORIALISM

An interesting recent paper by Simmons (1951) shows that interspecific territorialism is common among closely related species of chats, chatlike thrushes, and shrikes on their winter quarters and appears to have obvious adaptive significance. Among woodpeckers, Selander and Giller (1959) have shown that two closely allied species, *Centurus carolinus* and *C. aurifrons*, show marked interspecific territorialism in their narrow zone of sympatric occurrence in central Texas. A third species, *Melanerpes erythrocephalus*, of similar size, while differing widely in appearance and to a noticeable extent in food foraging habits, still demonstrated aggressive behavior to a marked degree when presented with dummy mounts of *C. carolinus*. It seems conceivable that, should the nesting territories of these species in a zone of overlap become accidentally compressed, the phenomenon of aggressive neglect might come into play.

#### AGGRESSION IN WATERFOWL SPECIES

Aggression is very marked in certain species of waterfowl, particularly among shelducks and certain geese placed in the tribe *Tadornini* by Delacour and Mayr (1945). Many of these species occur in what might be described as marginal habitats, close to the snow line in the moun-

tains, or in xeric zones, or on barren islands. Species such as the Egyptian and Blue-winged geese, the Cereopsis and Andean geese, the Paradise and other Shelduck, and the Crested Duck are occupants of widely spaced territories in the breeding season and will fight savagely among their own kind, or with other waterfowl species.

A notable example under semiwild conditions is that of the population of Trumpeter Swan, *Olor buccinator*, in the Red Rocks Federal Refuge in Montana. There is a specific carrying capacity of the lake. A certain number of pairs of swans occur that can nest. The rest are said to be nonbreeders, which, in fact, would seem to mean birds that for one reason or another have been prevented from breeding by the constant territorial fighting. It is a fact as shown by annual censuses that the reproductive rate of the successful breeding pairs is materially cut down as the total population increases. Perhaps this is directly correlated with the need for constant aggressive defense of territory, as there is no diminution of food supply.

On my waterfowl preserve I attempted for several years to keep Blue-winged Geese, *Cyanochen cyanopterus*, at liberty in the large pond that contained other species of geese. During the spring breeding season the Blue-winged pair spent a large part of their time attacking other species such as the Barnacle Geese, *Branta leucopsis*, even while the latter were nesting. The Barnacles and other species nested successfully, while no attempt was made by the Blue-wings to nest, although pairing was noted. Later, placed in a small enclosure by themselves, the Blue-wings nested successfully.

In the case of waterfowl living in a marginal habitat such as the wind-swept, exposed islands off the coasts of southwestern Australia and Tasmania where the Cereopsis Geese, *Cereopsis n. hollandiae*, occur, it is conceivable that a behavior pattern such as aggressive neglect could be of adaptive significance if for any reason the habitat should become constricted so that the population resulting from a normal reproductive rate could not be supported. Thus the factor of aggressive neglect could vary between species, serving as a useful mechanism to a lesser degree, as clutch size has been shown to be adaptively significant by Lack in his many publications.

#### SUMMARY

Field observations in the Moluccan Islands of eastern Indonesia indicate that interspecific competition may involve a phenomenon in which the dominant, more aggressive species maintains a reduced numerical ratio to a partially competing species with which it is sympatric by its

very aggression and consequent reduction in brood size or nesting success. Other possible examples are sought, and it is suggested that this phenomenon could occur in cases of interspecific territorialism under constricted conditions. Possible cases among aggressive species of waterfowl are considered.

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## THE GENERA OF AMERICAN GROUND DOVES

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THE several species of small American columbids generally termed ground doves comprise a relatively homogeneous assemblage. Nevertheless, the species have received varying treatment generically. Salvadori (1893) recognized eight genera and 17 species, Peters (1937) seven genera and 17 species, Hellmayr and Conover (1942) 10 genera and 16 species, and Goodwin (1959) five genera and 17 species. Hellmayr and Conover emphasized differences among the species and consequently recognized many genera, whereas Salvadori (for his time), Peters, and Goodwin emphasized similarities among the species and consequently recognized few genera.

The immediate purpose of the following account is to assess the validity of the genus *Scardafella* Bonaparte and the genus *Columbina* Spix, *sensu* Goodwin (1959). The genera *Claravis* and *Metriopelia* are not here treated; Peters and Goodwin do not differ in their taxonomic views of the two genera, and I have nothing of importance to add to their remarks.

Specimens examined in the course of my study are housed at the Museum of Natural History, The University of Kansas; the Museum of Vertebrate Zoology, Berkeley; the Museum of Zoology, The University of Michigan, Ann Arbor; the United States National Museum, Washington, D.C.; The American Museum of Natural History, New York. Observations on some of the species in the field were made in Arizona, New Mexico, Texas, Sonora, Nayarit, Veracruz, Oaxaca, and Chiapas. Live doves of most of the species mentioned here were observed in the Bronx Zoo, New York; the Brookfield Zoo, Chicago; San Francisco Zoological Gardens; the San Antonio Zoo, San Antonio. Financial assistance was received from the American Academy of Arts and Sciences, the NAS-NRC Committee on Research in Problems of Sex, The National Science Foundation, and the General Research Fund of The University of Kansas. Permission to take specimens in México was received from the Dirección General de Caza of the Secretary of Agriculture, through the courtesy of Sr. Luis Macias Arellano.

Goodwin (1959: 512) has proposed that the genera *Eupelia* and *Columbigallina* be placed in the genus *Columbina*. The argument for such treatment emphasizes similarities of the species involved, rather than differences; this argument is persuasive and probably correct. Yet, the fact that there are differences among the species is important to bear in mind. Recognition of such differences is not so much

to emphasize heterogeneity as it is to admit that some exists, and this is useful in gauging degrees of relationship obtaining in the inclusive genus.

*Columbigallina*, as treated by Peters, included the species *passerina*, *minuta*, *cruziana*, *buckleyi*, and *talpacoti*. *C. passerina* and *C. minuta* are morphologically the closest of the five, although they are by no means close enough to be considered sibling species, and the other three species are well removed from any hypothetical common ancestor. The five species share in common a short tail lacking white marks, rounded wings having dark or iridescent signal markings on the coverts, and some kind of emargination on the trailing edge of primary feather 7 (Johnston, 1960: Figure 1). The only species showing any aberrancy in these characters is *cruziana*, the lobe on primary 7 (the lobe is there, contrary to Todd, 1913: 512) being simple and lacking the recurved edge characteristic of the other species. Beyond this there are a few external divergences; *cruziana*, *buckleyi*, and *talpacoti* have broad, blade-shaped 10th primaries that lack subterminal extension of barbs forming a fringe, and *talpacoti* and *buckleyi* have a row of small feathers on each side of the tarsus. Todd (*loc. cit.*) and Hellmayr and Conover (1942) treated *cruziana* as of another genus (*Eupelia*), but I see no reason to remove *cruziana* from the group of five species mentioned above, unless the genus *Columbigallina* is to be split into at least three genera.

According to all authors, *Scardafella* is composed of the allopatric species *inca* and *squammata*, although Hellmayr and Conover considered the two kinds to be one polytypic species. Species of *Scardafella* lack signal markings on the wings and have long, white-marked tails, but otherwise resemble *Columbigallina*. The long tails of these birds caused Goodwin to exclude *Scardafella* from his inclusive genus *Columbina*. Tails of these species are used in the species-specific aspect of epigamic display; observations on comparative behavior suggest that the species-specific aspect of columbine courtship is an isolating mechanism (see below for details). If so, tails and behavior associated with their use are more sensitive in an evolutionary sense than structures lacking such significance. Therefore, tails should be considered less reliable indicators of phylogenetic relationships than are more conservative structures.

*Columbina* (*sensu stricto*) is monotypic. The tail of *C. picui* resembles that of *Scardafella*, and the signal markings on the wings resemble some of those in *Columbigallina*. *C. picui* in certain other respects is intermediate between *Columbigallina* and *Scardafella*, and it would be

difficult to include *C. picui* in either of those genera as presently constituted.

*Behavioral considerations.* Behavior associated with wings is especially well developed in doves. Throughout the family, wings are used (aside from flight) as weapons, to signal anxiety, and to give the prime solicitation signal in courtship feeding. Few species have highly elaborated signal markings on the wings, but most have some sort of modification in shape of some of the feathers, apparently associated with production of sound. The particular features vary from one group of species to another (rather than from one species to another), and as such they are more useful as taxonomic characters than any other morpho-behavioral feature associated with wings.

All eight species here considered have posteriorly emarginated 7th primaries, and two of the eight have such emarginations on the 6th primary; the function of such shapes is thought to be the production of sounds used in communication of individuals in groups. The sounds are of the same functional order as vocal flight calls of other kinds of birds (and none of these doves has a flight call). No other species of dove from North or South America has such emarginations on the feathers mentioned. The similar emarginations present on primaries 6, 7, 8, and 9 of species of *Claravis* are best considered independent acquisitions.

Four of the eight species also have an extension of barbs subterminally on the 10th primary, forming a faint fringe on the trailing edge; the fringe may be a vestige of an extension of barbs resembling the extension found on the 7th primary. The fact that *passerina*, *minuta*, *inca*, and *squammata* all have fringes is to me the strongest evidence available that the four species are closely related.

The several morphologic features mentioned above are listed in Table 1, together with their distribution among the eight species of doves.

A few more nearly strictly behavioral patterns have some bearing on estimates of relationships among the eight species here treated. But it should be emphasized that the entire realm of ritual behavior concerned with relationships between the sexes is of minor significance in estimating relationships of doves. Heretofore, too much emphasis has been placed on the configuration of courtship sequences as an aid in indicating relationships.

In most pigeons and doves epigamic behavior consists of four distinct, serially oriented rituals: head bobbing, heteropreening, bow-coo, and courtship feeding. In pair formation, these appear in each season of

TABLE 1  
DISTRIBUTION OF CERTAIN MORPHOLOGICAL CHARACTERS  
IN EIGHT SPECIES OF AMERICAN GROUND DOVES

	<i>Species</i>							
	<i>passerina</i>	<i>minuta</i>	<i>cruciana</i>	<i>buckleyi</i>	<i>talpacoti</i>	<i>inca</i>	<i>squamata</i>	<i>picui</i>
Emargination on primary 6	o <sup>1</sup>	o	o	o	o	x	x	o
Emargination on primary 7	x	x	x	x	x	x	x	x
Iridescent or dark spots on wings	x	x	x	x	x	o	o	x
Narrow primary 10, subterminal incision	x	x	o	o	o	x	x	x
Extension of barbs on primary 10	x	x	o	o	o	x	x	o
Short tail with no white marks	x	x	x	x	x	o	o	o
Nude tarsus (no rows of feathers)	x	x	x	o	o	x	x	x

<sup>1</sup> Presence of character indicated by "x," absence by "o."

breeding in about the order just listed, and they are used serially, subsequent to pair formation, in the preliminaries of any attempt at copulation. Two exceptions can be noted: first, courtship feeding is not essential to pair formation, but is necessary before copulation can occur, and second, the bow-coo is occasionally left out of the precopulatory sequence. Even so, the bow-coo is easily the most important ritual in pair formation because the bow-coo is the only one of the series of acts that is species-specific (for example, the vertical tail fanning of *S. inca*, *Geopelia* spp., *Leucosarcia*, *Zenaida asiatica*, etc., the strut and coo of *Columbia* spp., and the "classical" bow-coo of *Streptopelia* spp.). As the only species-specific element in sexual behavior of doves, the bow-coo can be expected to become subject to intense selection to form an effective isolating mechanism. That the bow-coo is a behavioral isolating mechanism is clearly shown in *Streptopelia*, where female parental individuals of *S. decaocto* and *S. risoria* do not even respond to the bow-coo of (experimentally produced) male  $F_1$  hybrids (Konrad Lorenz, personal communication). This isolating mechanism is sex linked,

and males are much less discriminating than females, but it is markedly effective in *Streptopelia*. Such selection pressure in the past would explain how the bow-coo today can be expressed with such variation, even in species that are otherwise seemingly closely related. I can conclude only that the bow-coo cannot be used as evidence for or against close relationship in doves, especially at the generic level.

Likewise, the remainder of the epigamic *Gestalt* is of little use in tracing relationships at a level below that of subfamily; all species that I have seen in the field, in captivity, or have read about, seem to have nearly identical bobbing, heteropreening, and courtship feeding routines.

Information of some relevance on additional behavioral features may be treated summarily: *picui* (Hudson, 1920: 159), *inca*, and *talpacoti* form flocks in winter, but *passerina* does not; none of the species seems to clap the wings in flight; *crusiana* (Marchant, 1960: 356), *picui* (Friedmann, 1927: 171), *talpacoti*, *inca*, and *passerina* pay no attention to sanitation at the nest and frequently use the reinforced nests more than once in one season of nesting (Johnston, 1960: 14).

*Note.* Salvadori erroneously set aside the genera *Geopelia*, *Scardafella*, and *Gymnopelia* in a distinct subfamily, the Geopeliinae. Although no one today believes that subfamily to be valid, there has been sporadic belief that *Scardafella* and *Geopelia* are closely related in some way, owing to the remarkable resemblance in plumage and behavior between *S. inca* and *G. striata*. Point for point comparison of 12 morphologic and behavioral characters has shown that the resemblance between *S. inca* and *G. striata* is really an instance of convergence (Johnston, MS). Moreover, if modalities of morphology and behavior found in *Geopelia* (considering the most divergent species, *G. humeralis* and *G. cuneata*, as well as *G. striata*) are compared with those of *S. inca* and *S. squammata*, the grounds for any relationship at the level of subfamily are eliminated. Once such grounds are eliminated, a puzzling "problem" in biogeography is also eliminated: the Australasian *Geopelia* is an Old World autochthon, probably allied to *Streptopelia*, and the Neotropical *Scardafella* is a New World autochthon, clearly allied to other doves of that region.

As one last point, it will have been noticed that the affinities of *Oxytelia cyanopsis*, included by Goodwin in his genus *Columbina*, have not been discussed here. Practically nothing is known about *O. cyanopsis*, but to judge by external morphology alone the species is best considered to lack close contemporary relatives. At all events, *O. cyanopsis* cannot be considered a congener of any ground dove discussed here.

#### CONCLUSION

The evidence presented here, plus that discussed by Goodwin (1959), shows the eight species to be alike in many features. Moreover, the

differences amongst them are so unevenly distributed (Table 1) that no useful line can be drawn to separate any one species from the remainder at the generic level, and the reference of the species to two or more genera will continue to obscure relationships. Therefore, the genus *Scardafella* Bonaparte (1855) should be placed in the synonymy of *Columbina*. The genus *Columbina* Spix and included species should stand as listed below.

# Genus **COLUMBINA** Spix

*Columbina* Spix, Av. Bras., 2, 1825, p. 57, 58. Type, by subsequent designation, *Columbina strepitans* Spix. (G. R. Gray List Gen. Bds., ed. 2, 1841, p. 75.)

*Columbigallina* Boie, Isis von Oken, 1826, col. 977. Type, by monotypy, *Columba passerina* Linnaeus.

*Scardafella* Bonaparte, Compt. Rend. Acad. Sci. Paris, 40, 1855, p. 24. Type, by original designation *Columba squamosa* Temminck (not of Bonnaterre) = *Columba squammata* Lesson.

*Eupelia* Todd, Ann. Carnegie Mus., 8, 1913, p. 512. Type, by original designation, *Columba cruziana* Prévost and Knip (= Prévost).

**Columbina passerina** (Linnaeus): Common Ground Dove

**Columbina minuta** (Linnaeus): Minute Ground Dove

**Columbina cruziana** (Prévost): D'Orbigny Ground Dove

**Columbina buckleyi** (Sclater and Salvin): Buckley Ground Dove

**Columbina talpacoti** (Temminck): Ruddy Ground Dove

**Columbina squammata** (Lesson): Scaled Dove

**Columbina inca** (Lesson): Inca Dove

**Columbina picui** (Temminck): Picui Ground Dove

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## THE CONNECTICUT WARBLER IN MICHIGAN

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THE breeding area of the Connecticut Warbler, *Oporornis agilis*, extends from the Peace River area of British Columbia (Cowan, 1939) eastward through Alberta (R. C. Harlow in Bent, 1953; Soper, 1949; Godfrey, 1952), Saskatchewan (Godfrey, 1950), Manitoba (Seton, 1884; Macoun and Macoun, 1909; Cartwright, 1931; Short and Waller, 1937; Godfrey, 1953), Ontario (Magee, 1923; Baillie and Harrington, 1937; Baillie, 1950; Todd, 1943; Smith, 1957; Brown, 1947) to Quebec (A.O.U. Check-list, 1957; Smith, 1957). The southward limits apparently are in northern Minnesota (Huff, 1929; Kilgore and Breckenridge, 1929), northern Wisconsin (Gromme, 1942), and northern Michigan. A considerable number of observations have been accumulated during more recent years in northern Michigan. Because these have been made at the southern limit of the breeding range, they are of importance to our knowledge of the distribution as well as the general biology of the species.

## MICHIGAN RECORDS

There have been many misidentified birds recorded as Connecticut Warblers in the Michigan literature. We will attempt here to make the necessary corrections.

1. O. B. Warren (1895: 192) reported a nest of the Connecticut Warbler in Marquette County in August 1894 but later (1898: 193) wrote that it was a mistake and that these birds were Yellowthroats (*Geothlypis trichas*).

2. N. A. Wood (1905: 178), and Wood, Peet, and McCreary (1906: 119) claimed that a female and young were taken in the Porcupine Mountains, Ontonagon County, in the summer of 1904. Wing (1940: 191) and Wood (1951: 414) corrected this when they found the birds were Mourning Warblers (*Oporornis philadelphia*).

3. E. A. Arnold (Kilgore, 1930: 24, 26) is said to have collected a set of two eggs of the Connecticut Warbler 27 May 1899 in Calhoun County. Since we have lived nearly all of our lives in and adjacent to Calhoun County, and we and no one else has ever seen the species there in summer, we feel this record is not valid. Mourning Warblers occasionally will remain this far south in Michigan, but we know of no logical Connecticut Warbler habitat in this or any nearby county.

4. J. Claire Wood (1905: 130) has recorded a sight observation of this species near Detroit, 3 July 1905, but this has already been discounted by Zimmerman (1955: 15), and we agree with Zimmerman.

5. Josselyn Van Tyne (1923: 25) observed a pair on 19 July 1919 at Mismar Bay, Les Cheneaux Islands, Mackinac County. The female had food in her bill and scolded as though young were nearby. He also saw a female bird near

Hessel, Mackinac County, on 9 August 1919. These appear to be the first authentic summer records.

6. Cheboygan County, Burt Lake. Fortner and Metcalf (1929: 250) observed two Connecticut Warblers on 12 July 1921 in a cedar bog but gave no details. The birds were not collected.

7. Chippewa County, Munuscong State Park. On 10 June 1934 Walkinshaw collected a singing male and observed another on 14 June 1934.

8. Luce County, McMillan. Bryens (1941: 48) observed a Connecticut Warbler south of here on 23 July 1922. The area in which he lived was not typical breeding habitat, so the bird must have been a wanderer. In the great Tahquamenon Swamp, Walkinshaw (1936: 220) found two singing males on 9 June 1935 and observed these birds 10, 11, 12, and 18 June 1935. We returned to the area in 1948 and observed two singing males daily from 23 June until 3 July. We observed another singing male here on 2 July 1958.

9. Alger County, five kilometers (three miles) east of Shingleton. On 1 July 1941 G. A. Ammann (1944: 48) observed a singing male.

10. Chippewa County, Trout Lake. On 29 May 1948 Ammann (Wallace and Black, 1948: 173) found seven, possibly eight, singing male Connecticut Warblers.

11. Schoolcraft County, Seney, five kilometers (three miles) east. We found a singing male here on 26–28 June 1952.

12. Ontonagon County, seven kilometers (four and a half miles) north of Ewen. Arthur Peters (notes to University of Michigan Museum of Zoology) found several singing males in the summer of 1954. On 21 June 1956 Dyer with Dr. and Mrs. W. Powell Cottrille observed several singing males. On 13, 17, and 18 June 1957 the Cottrilles, Mr. and Mrs. Arthur Peters, and we found eight singing male Connecticut Warblers, and on 1 July 1960 we found the first Michigan nest. On 2 July 1960 Eliot Porter, Betty Cottrille, and we found a young bird out of a nest some little distance north of the nest that we found the previous day. One specimen was taken.

13. Marquette County, 20 kilometers (12 miles) east of Marquette. We found a singing male on 13 June 1957 in a jack pine, semi-open area.

14. Oscoda County, Red Oak (T28N,R1E, section 26). D. Zimmerman (1955: 12–19) found a singing male Connecticut Warbler on 30 June 1954 and collected another 9 July 1954. D. Middleton, A. J. Berger, and W. P. Nickell (Kenaga, 1960: 37) found a Connecticut Warbler in Oscoda County 18–24 June 1959.

#### MIGRATION AND BEGINNING NESTING

The Connecticut Warbler is a late-spring migrant, usually arriving in southern Michigan late in May. Some birds are observed even into the first few days in June. At Battle Creek, Calhoun County, Walkinshaw has observed singing males on 23 and 27 May 1930, 22 and 23 May 1931, 26 and 27 May 1937, 22, 24, and 26 May 1938, 30 May 1945, 21 May 1946, 4 June 1954 and in Lee Township, Calhoun County, 18 May 1957; in Muskegon County, 29 May 1954 and 31 May 1958. With William Freeman, we observed a singing male near Cross Village, Emmet County on 29 May 1960.

Spring University of Michigan Museum of Zoology specimens indicate a similar trend in migration:

Berrien County (Birchwood Beach) by N. A. Wood 27 May (3 females), 29 May (1 female), 30 May (1 female) 1918.

Kalamazoo County (Kalamazoo) by F. H. Chapin 23 May 1880 (1 male), 28 May 1883 (1 male). (Gull Lake) by C. J. Henry 19 May 1933 (1 male).

Washtenaw County (Ann Arbor) by N. A. Wood 18 May 1911 (1 male); 25 May 1913 (1 male); by A. D. Tinker 3 June 1928 (1 male).

Wayne County (Grosse Ile) by B. H. Swales 5 June 1907 (1 male, 1 female); (Detroit) by D. Middleton 22 May 1950 (1 male).

Iosco County (Hale) by C. Owens 31 May 1954 (1 female).

From the date of the nest that we found in Ontonagon County, Michigan, on 1 July, with young already leaving the nest and young out of another nest the following day, it would appear that egg laying would have begun by 5 June and nest building in late May or early June.

Probably many of the migrating males of late spring in Michigan are going farther north into Canada to breed.

During the spring migration the male Connecticut Warbler often sings rather regularly in the early morning, and it is because of this that we have been able to locate the birds. Often they go along a brush-grown roadside moving northward and singing as they go but usually near the ground.

#### SONG AND SCOLDING NOTES

Much has been written about the Connecticut Warbler's song. It is very loud and penetrating. We feel that it is even louder than the songs of Water-thrushes and the Kirtland Warbler (*Dendroica kirtlandii*). Seton (1884) described the song as *beechee-beechee-beechee-beechee-beechee-beechee* and later as *Fru-chapple fru-chapple fru-chapple whoit*.

One description by us has been *freecherty-freecherty-freecherty-freech*. Again it resembled *Virginia-virginia-virginia* and again a shorter song resembling the song of the Yellowthroat *Weechery-weech*. At McMillan in 1948 we watched two males every morning for some time. Usually they began singing very early in the morning, but on 24 June the first male sang at 0520 and the next morning it was even later, at 0618. On 1 July one male began singing at 0521 while on 3 July one male was singing when we arrived at 0530 and continued to sing until 0607. In 1935 two males were timed at 0500, singing at the rate of six times per minute. We found that males preferred



Figure 1. Female Connecticut Warbler, 1 July 1960, four and one half miles north of Ewen, Ontonagon County, Michigan.

to sing about six-eight meters from the ground in a taller, dense tree and often did not move from that spot for a long period of time. They were even hard to flush at times from their singing perch. Powell Cottrille shook a tree at Ewen in June 1956 while the bird was singing, and it continued to sing regardless.

The scolding note is unique and different than any scolding note we have heard, a sharp *plink*, higher pitched than the call of the Mourning Warbler. Both birds gave this call, and because they were so vociferous we knew where they were nearly all of the time until they ran (not hopped) around close to our feet.

The population of Connecticut Warblers in Michigan has never been sufficiently dense for the development of conspicuous territorial defense. The male that we found at Ewen was singing at least 145 meters from the nest and about 235 meters from the next nearest male Connecticut Warbler. We watched him for some time, when suddenly he flew to the opposite side of the tree, captured an insect, and flew northward between two evergreen trees. When we reached the approximate location, both the pair of Connecticut Warblers and a pair of Mourning Warblers scolded us. Neither paid much attention to the other.

#### NESTING

The above Connecticut Warblers were very vociferous and came regularly with food for the five young. They landed near the nest site, then walked beneath the vegetation for the last 9-15 meters, so that it required some time actually to locate the nest.

The vegetation above and within a meter of it included: Bracken fern (*Pteris aquilina*), a very small basswood (*Tilia americana*), some strawberry (*Fragaria* sp.?), a violet (*Viola* sp.?), morning glory (*Ipomoea* sp.?), goldenrod (*Solidago* sp.?), fireweed (*Epilobium angustifolium*), and large-leaved aster (*Aster* sp.?).

In the vicinity were white pine (*Pinus Strobus*), white spruce (*Picea canadensis*), black spruce (*Picea mariana*), balsam (*Abies balsamea*), cat-tail (*Typha latifolia*), large blue flag (*Iris versicolor*), some willows (*Salix* sp.), scattered quaking aspens (*Populus tremuloides*), marsh marigold (*Caltha palustris*), gold-thread (*Coptis trifolia*), meadowsweet spirea (*Spirea salicifolia*), shadbush (*Amenanchier canadensis*), golden avens (*Geum strictum*), red raspberry (*Rubus idaeus*), thimbleberry (*Rubus* sp.), some clover (*Trifolium* sp.), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), red-osier dogwood (*Cornus stolonifera*), black ash (*Fraxinus nigra*), dogbane, self-heal (*Prunella vulgaris*), ironweed (*Veronia altissima*), yarrow (*Achillea* sp.), and hawkweed (*Hieracium aurantiacum*).

The trees were widely scattered, with many openings between, producing a rather parklike area. The water plants grew along the side of a very small stream. In the majority of clearings, grass, some

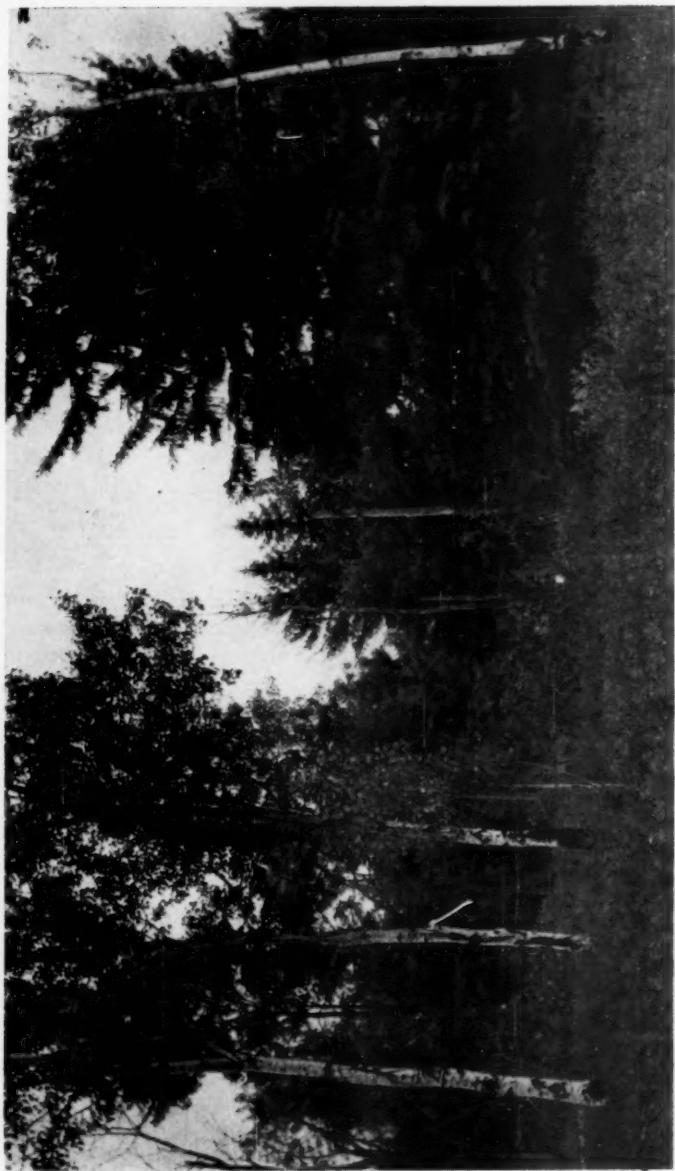


Figure 2. Nesting habitat of Connecticut Warbler, north of Ewen, Ontonagon County, Michigan.

timothy, and, in places, some sedges grew. The ground cover was extremely dense.

The nest rested on dry ground. It was very bulky and when collected and dry weighed 19.8 grams. The outside dimensions were 120 x 142 mm. across and 55 mm. deep. Inside it measured 59 mm. across and 52 mm. deep. It was made of a foundation of dead leaves and other dead debris piled into a mass, then lined with coarse grass with finer grass on the interior. Like many birds that build nests in both bog and on dry land, Connecticut Warbler nests vary according to their location. The one described by Huff (1929) was not bulky, and was sunken into sphagnum moss. Nashville Warblers (*Vermivora ruficapilla*) and Palm Warblers (*Dendroica palmarum*) both nest similarly to the Connecticut Warbler—on dry land and in bogs in the sphagnum moss. The Palm Warbler, however, usually builds its nest on top of the moss; the Nashville Warbler in the moss on the side of a hummock. The nest of the Connecticut Warbler is more like the nest of the Palm Warbler than like that of the Nashville.

The juvenal nestling Connecticut Warbler is quite dark on the back, a dark brown with no evidence of any lighter markings at all. There is no eye ring. The sides beneath are lighter brown, becoming yellow below. The throat is buffy. The toms are yellow; the inside of the mouth a pinkish-orange. The legs are light-flesh color. Weights of two of the nestlings ready to leave the nest were 10 grams. Wings of four measured, 36, 36, 36, and 35 mm.; tails, 6, 6, 7, and 7 mm.; tarsi, 20, 21, 22, and 22 mm.; culmen 8.2, 8, 8, and 8 mm. The adults were caught and measured. The male weighed 13.5 grams. His wing measured 68 mm.; tail, 54 mm.; tarsus 21 mm.; exposed culmen, 12 mm. The female weighed 13.2 grams. Her wing measured 69 mm.; tail, 51 mm.; tarsus, 20 mm.; exposed culmen, 12 mm.

The average wing measurement of 15 males in the University of Michigan Museum of Zoology was 71.5 mm.; 9 females, 66.8 mm., considerably longer than wings of the Mourning Warbler. In addition to the longer wing the Connecticut Warbler has longer under tail coverts, and adults always have a distinctive white orbital ring. The male is olive-green above, gray without any black on the throat, and yellow below this. The female is browner on the throat but also has the complete eye ring.

#### FALL MIGRATION IN MICHIGAN

There has been some suggestion of possible differences in migratory route in the fall from that of spring. Yet a number of specimens exist



from southern Michigan indicating that many birds must follow the same route as in the spring. The following specimens are in the University of Michigan Museum of Zoology:

Isle Royale by W. G. Fargo 4 Sept. 1924 (1 juv. female).

Chippewa County (Munuscong State Park) by W. G. Fargo 5 Sept. 1927 (1 juv. female).

Saginaw Bay (Charity Island) by N. A. Wood 3 Sept. (1 female), 6 Sept. (1 female), 8 Sept. (1 male), 15 Sept. (1 female) 1910.

Muskegon County (Laketon Twp.) by L. H. Walkinshaw 14 Sept. 1957 (1 male).

Livingston County (Edwin S. George Reserve) by G. M. Sutton, 5 Sept. 1940 (1 juv. female); (Whitmore Lake) by R. E. Stewart 3 Sept. 1938 (1 female).

Jackson County (Portage Lake) by R. E. Stewart, 27 Aug. 1938 (2 females).

Washtenaw County (Ann Arbor) by N. A. Wood, 13 Sept. 1926 (1 male). (Pittsfield Twp.) by A. J. Berger, 7 Sept. 1955 (1 juv. male).

Wayne County (Palmer Park) by B. H. Swales, 8 Oct. 1905 (1 female); 30 Sept. 1906 (1 female).

#### SUMMARY

The Connecticut Warbler has been found in summer from the Peace River Parklands eastward to Rupert House, Quebec, southward to Aitkin County, Minnesota, at Wascott, Douglas County, Wisconsin, and now at Ewen, Ontonagon County, Michigan, and at times even into the Lower Peninsula, at Red Oak, Oscoda County, Michigan. A nest was found in northern Michigan on the ground in an aspen, balsam parkland. It contained five young, all ready to leave the nest on 1 July 1960. They left during the day.

Young birds (probably about 9 or 10 days old) are an olive-brown on the back, without any wing bars and no eye ring. Below, on the sides, they are a lighter brown, the same on the throat, gradually blending to yellow on the lower parts. The toms are yellow; the inside of the mouth, pinkish-orange. The legs are light-flesh color.

Food of the young consisted of moths, green larvae, and other insects brought by both parents. Excreta were usually carried away from the nest at this time.

The juvenal Connecticut Warblers weighed 10 grams. Their wings measured 35-36 mm. Adults weighed 13.2 and 13.5 grams. The average wing measurement of 15 males in the University of Michigan Museum of Zoology was 71.5 (69-74) mm.; of 9 females, 66.8 (64-70.5) mm.

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## NEST-SITE TENACITY AND HOMING IN THE BUFFLEHEAD\*

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BANDING data for the Bufflehead (*Bucephala albeola*) have not previously been summarized. In this paper, nest-site tenacity and homing tendencies are discussed on the basis of evidence from banding, and some of the shortcomings of Bufflehead banding are pointed out. Many generalizations for that species may have some application to other ducks.

The Bufflehead is more suitable than most other ducks for a study of nest-site tenacity. Its nests in cavities made by Flickers (*Colaptes*) are easily found, at least in favored breeding areas in British Columbia and Alberta. Previously, such studies (*e.g.*, Sowls, 1955) have used ground-nesting species, but tree nests have the major advantage in that they are fixed in location and may be revisited in subsequent years without need for further search. Other ducks that nest in trees require larger cavities, which, except when nest boxes are used, are much less easy to locate. The Bufflehead is relatively long-lived, so that individual birds may be recaptured in several successive years.

### SOURCES OF DATA

Banding of Buffleheads may be classified as systematic or fortuitous. Most important in the former category is the work of the Department of Zoology, University of British Columbia, and of the British Columbia Game Commission. Flightless young and molting adult Bufflehead were banded in the central plateau region of British Columbia, where the Bufflehead is an abundant breeder, using a drive-trapping technique developed for diving ducks (Cowan and Hatter, 1952). Much of the material presented in this paper is derived from retraps and recoveries of the approximately 2,000 Bufflehead banded in that area in 1948-1955 and 1957-1959. The writer studied the Bufflehead during the summers of 1958 and 1959, while preparing a thesis at the University of British Columbia (Erskine, 1960). Nests located during those summers were rechecked in 1960 by Lawson G. Sugden (formerly with the B.C. Game Commission), Canadian Wildlife Service, Edmonton, Alberta.

Other banding of Buffleheads has been classed as fortuitous in that

\* This study is a contribution from the Department of Zoology, University of British Columbia, and from Canadian Wildlife Service. This paper was delivered in essence at the Seventy-eighth Stated Meeting of the American Ornithologists' Union, on 26 August 1960, in Ann Arbor, Michigan.

those birds were caught during drive- or bait-trapping operations aimed at other species. Most work in that category was done by Ducks Unlimited co-operators in the Prairie Provinces (1939-1950), and by the state game departments of New York (1955-1959), Maryland (1956-1959), and Oregon (1947-1959). Banding by Ducks Unlimited was mostly in August and September, although a few birds were banded in late May and early June. Banding in the other regions was almost exclusively carried out from January through March.

#### USAGE OF NEST SITES

In central British Columbia a turnover of about 50 per cent was found in usage of Bufflehead nests. Table 1 presents the available data on reuse.

TABLE 1  
(a) NEST USAGE BY BUFFLEHEADS

<i>Year</i> <sup>1</sup>	<i>Nests used</i>	<i>Nests reused next year</i>	<i>Nests unusable next year</i>
1952	6	1	2
1953	2	2	—
1954	3	—	2
1955	2	—	—
1957	16	9	—
1958	39	25	2
1959	71	33	2
Total <sup>2</sup>	139	70	8

<sup>1</sup> Data for 1952-1954 were provided by Miss Mary F. Jackson, and those for 1955 and 1957 (in part) by M. Timothy Myres.

<sup>2</sup> Forty-eight nests occupied in 1960 were omitted from the table, since no data on subsequent use were available.

(b) REUSE OF INDIVIDUAL NESTS

	<i>Number of consecutive years in which nest used</i>			<i>Used more than once in broken sequence</i>
	4	3	2	
No. of nests	6	10	34	6

Table 1(a) shows that part of the annual turnover is due to nests becoming unusable, usually because the tree fell down or the cavity became unsuitable. Nests in Aspen (*Populus tremuloides*) are much less durable than nests in Douglas Fir (*Pseudotsuga menziesii*) stubs. One site in Douglas Fir was used by Bufflehead in 1941 (Munro, 1942).

and again in 1954 (Jackson, *in litt.*), and the site was still suitable for occupation by Buffleheads in 1960.

#### SITE TENACITY OF INDIVIDUAL BIRDS

Some investigators (*e.g.*, Munro, 1958; H. W. Burns, *in litt.*) have stated that Bufflehead nests may be used for many years in succession. However, that is not always true, and occupation of a given site in

TABLE 2  
HISTORIES OF FEMALE BUFFLEHEADS

Band number	Known history of bird
38-520461	Banded as young 1949; rebanded 515-42805 on nest at same lake 1957; on same nest 1958.
38-520622	Banded as young 1950; on nest at lake 1 km. away 1952; on same nest 1954; but not 1953.
505-50120	Banded as molting adult 1952; on nest at lake 155 km. away 1957; moved 265 m. W to new (re-)nest 1958.
505-50254	Banded as subadult (?) 1955; on nest at same lake 1957; on same nest 1958; also trapped with brood on same lake 1957 and 1958; rebanded 505-50497 on new nest 67 m. E in 1959 (renew); on same nest 1960.
505-50471	Banded on nest 1958; on same nest 1959.
505-50472	Banded on nest 1958; on same nest 1959.
505-50473	Banded on nest 1958; on same nest 1959.
505-50474	Banded on nest 1958; on same nest 1959.
505-50476	Banded on nest 1958; on same nest 1959 and 1960.
505-50477	Banded on nest 1958; moved 82 m. SE to new nest 1959.
505-50478	Banded on nest 1958; moved 450 m. SSE to next lake to new (re-)nest 1959; on same nest 1960.
505-50483	Banded on nest 1958; moved 1100 m. ESE to new nest 1959.
505-50486	Banded on nest 1959; on same nest 1960.
505-50491	Banded on nest 1959; moved 5 km. ESE to next lake to new nest 1960.
505-50493	Banded on nest 1959; on same nest 1960.
505-50494	Banded on nest 1959; on same nest 1960.
505-50495	Banded on nest 1959; on same nest 1960.
505-50498	Banded on nest 1959; on same nest 1960.
515-13721	Banded as young 1955; on nest at same lake 1957 (1958?, bird on same nest not caught); moved 70 m. SE to new nest 1959; moved 1200 m. W to new nest 1960.
515-13790	Banded on nest 1959; on same nest 1960.
515-13794	Banded on nest 1959; on same nest 1960.
515-42801	Banded on nest 1957; moved 900 m. E to new nest 1958; moved 180 m. S to new nest 1959; on same nest 1960.
515-42803	Banded on nest 1957; on same nest 1958 and 1959.
515-42804	Banded on nest 1957; moved 134 m. NW to new (re-)nest 1958; moved (from 1958) 255 m. ESE to new (re-)nest 1959; on same nest 1960.
525-19630	Banded as young 1957; on nest at same lake 1959; moved 75 m. W to new nest 1960.
525-19725	Banded on nest 1958; on same nest 1959.
545-40538	Banded as adult with brood 1958; on nest at same lake 1959; on same nest 1960.

consecutive years need not always involve the same bird. Table 2 gives the known histories of female Buffleheads captured on nests in more than one year.

Only two birds (505-50476 and 515-42803) were caught in three consecutive years on the same nest, while 19 others have been caught twice in the same nest, all but one (38-520622) in two consecutive years. One bird (505-50254 = 505-50497) was caught twice each in two nests, while two others (515-42801 and 515-42804) were also caught in four consecutive years, and one (515-13721) in three of four years in broken sequence. Those data are similar to the histories of individual birds obtained by SOWLS (1955) for ground-nesting ducks.

In all, Table 2 includes 35 cases of birds caught in two consecutive years. Table 3 shows the relative numbers of previously banded Buffleheads, handled on nests in earlier years, which were found on the same nest as before or on a different nest in 1958-1960. With one exception nest trapping began in 1957.

TABLE 3  
RELATIVE SITE TENACITY OF THE BUFFLEHEAD, 1958-1960

Year	Birds caught	
	in same nest as before	in another nest
1958	3	3
1959	7	6
1960	13	3
	23	12

Actually, the proportion of birds moving is probably lower under natural conditions. In 1957 and 1958 techniques for the nest study were being developed, and much more disturbance of nests resulted in those years than in 1959. However, desertion during the 1957 and 1958 nesting seasons was no more frequent than in 1959.

#### SURVIVAL OF BUFFLEHEADS

It is worth noting that birds first trapped on the nest in 1957 were frequently recaptured in later years (see Table 2). Mortality rates calculated from shot recoveries (cf. Hickey, 1952) are impossibly high, exceeding even the most optimistic estimates of production, but the samples are too small to be satisfactory. Of eight females first trapped



on the nest in 1957, seven were alive in 1958, five in 1959, and four in 1960, a mortality rate of about 17 per cent. Smaller proportions of birds first handled in 1958 and 1959 have been recaptured in subsequent years, however, and much more data are needed before such mortality rates can be accepted as representative of that population.

#### MOVEMENTS OF BUFFLEHEADS

The most important study of the movements of female ducks dealt with the renesting of dabbling ducks (Sowls, 1955). For the Pintail (*Anas acuta*) Sowls measured movements between original nests and re-nests of the same bird in 15 cases; distances varied from 78 to 1,370 meters, and averaged 258 meters. For the Bufflehead only movements between the nests in successive years are known, but the results appear comparable to those found by Sowls. Table 2 includes data on 12 such movements. Three were of less than 100 meters, four of 100-300 meters, and three of 900-1,200 meters; two others involved movements between lakes, one of 450 meters, and one of five km. The average distance was 797 meters; since the chances of recapturing birds at distances of over two km. are so slight as to be negligible, the one such value is best omitted from the calculation, leaving an average of 428 meters. The data given here suggest that a renesting study on Bufflehead could provide much valuable data in a short time.

#### HOMING

As shown in Table 3, homing by the adult female Bufflehead is often very precise; 23 cases out of 35 cited involving returns to the precise nesting site used previously. Breeding females usually return to their natal lake. Of nine birds banded as flightless young and recaptured on nests two to nine years later, six were at the lakes where they were banded and two others at lakes within one km. of the banding lake; one bird was found nesting five km. away in the next valley. Three other birds banded by drive trapping were also recaptured on nests later, while three more were captured with broods in two consecutive years, all captures of each individual being at the same lake. As shown above, 18 females banded on nests were later captured on nests at the same lakes, while two others had moved to other lakes. The one record of a female (505-50120) having molted 155 km. from a later nesting area indicates that in Bufflehead, as in other species (cf. Hochbaum, 1955), molting may take place far from the breeding areas.

## HOMING TO MOLTING AREAS

The molting areas of the male Bufflehead in British Columbia are unknown, but some data are available for females. Fourteen females banded while molting and five banded as young were later taken as molting adults. Ten were recaptured on the same lake, and five others within five km. of the points of banding. The other four, including two banded as young, were recaptured between 25 and 65 km. away. A tendency to return to the same molting area is suggested.

## HOMING TO WINTERING AREAS

Considerable numbers of Buffleheads have been banded on wintering areas and later shot or recaptured in the same general area. Data from Oregon, New York, and Maryland are summarized in Table 4, all birds included having been recaptured or shot in subsequent winter seasons.

TABLE 4  
HOMING TO WINTERING AREAS

Area	Sex	Recaptures (live)	Recoveries (shot)		
			under 15 km.	15-50 km. from point of banding	50-80 km.
Ore.	M	3	3		
	F	3	1		
N.Y.	M	24	11	3	3
	F	8	8	5	5
Md.	M	22	18		1
	F	4	4		1

For comparison, it may be worth mentioning that from New York bandings only six Buffleheads were recovered at localities more than 80 km. from the banding areas, during the months of December through March, and only one similarly from Maryland bandings.

Those data indicate that males as well as females are capable of homing to a precise locality, and males may well also home to breeding and molting areas (cf. Cartwright and Law, 1952).

## EVIDENCE AGAINST WINTER PAIRING OF BUFFLEHEADS

The most generally accepted hypothesis is that most pairing of waterfowl takes place on the wintering grounds (cf. Hochbaum, 1955), and that homing depends mainly upon the female. Banding data alone neither support nor refute that hypothesis.

One basis for the hypothesis is the repeated observation of courtship

among most species in such areas. However, it is known that courtship is also very common during migration and after birds arrive on the breeding areas. In the Bufflehead, courtship, including precopulatory displays, has been noted in wintering areas, but copulation has only been seen on the breeding grounds (Myres, 1959; Drury, verbal). This suggests that pairs are not consummated until the breeding grounds are reached, and further evidence suggests that frequently pair formation is also delayed.

Sex ratios of Buffleheads during spring migration in British Columbia provide evidence for migration of unpaired males. Such data are given in Table 5.

TABLE 5  
SEX RATIOS OF BUFFLEHEADS DURING MIGRATION

<i>Date(s)</i>	<i>No. adult males</i>	<i>No. females</i>	<i>Sex ratio (males/100 females)</i>	<i>Source of data</i>
(a) early in migration (just after lakes became open)				
5-6 Apr. 1958	132	9	1466/100	The writer Sugden, <i>in litt.</i>
10 Apr. 1959	149	22	677/100	
(b) later in migration (in 1959 about one week before the first eggs were laid)				
16-24 Apr. 1941	318	123	258/100	Munro, 1942 Sugden, <i>in litt.</i>
19 Apr. 1959	235	104	226/100	

On 5-6 April 1958 flocks of 10-20 males were seen on several occasions unaccompanied by females, so even the possibility that several males may accompany one female (cf. Munro, 1942) does not cover the observations. The evidence presented suggests that many, if not most, male Buffleheads must commence migration before pairing.

In order to prove or disprove the homing tendency in male ducks, whether Buffleheads or other species, it will be necessary to develop methods for capturing the males on their territories. To date that problem has been generally ignored.

#### ACKNOWLEDGMENTS

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supervised by Dr. I. McT. Cowan, Head, Zoology Department, University of British Columbia. The 1960 studies were supported by the Canadian Wildlife Service, Department of Northern Affairs and National Resources, Ottawa, Ontario. Data on the bandings in areas other than British Columbia were provided by the organizations involved. The help of Miss Mary F. Jackson, M. Timothy Myres, A. James Wiggs, William D. McLaren, and Lawson G. Sugden is gratefully acknowledged.

#### SUMMARY

Female Buffleheads exhibit a tendency to home to their natal lake, often returning to the precise nest site used in previous years. Reuse of a given nest site may be prevented by its having become unusable, or disturbance during the previous nesting season may induce a move to another site. The homing tendency and the distance of moves between nests are similar to those established earlier for other species of ducks.

Female Buffleheads also tend to return to molting areas, while both sexes return to wintering grounds used in previous years. Evidence is presented to suggest that male Buffleheads may home to the breeding grounds, often independently of the female.

Banding male ducks on their territories seems the logical way to prove homing in drakes, but this is lacking for the Bufflehead and for other ducks.

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## ADRENAL AND THYROID WEIGHTS IN BIRDS

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LITTLE study has been made of the relative sizes of adrenal and thyroid glands in different species of birds. One of us (Hartman, 1946) reported such a study on birds collected in the United States some years ago. In this paper, results on birds collected in Panamá include a number of families and species not found in the United States, some migrants from the United States, and two domestic species, *Gallus gallus* and *Coturnix coturnix*.

Data from 249 species in 49 families are reported. Specimens were obtained during December and January near sea level on the Rio Chagres and during February and March at 1,300 meters elevation near the village of El Volcán in the Province of Chiriquí.

This material was also used to study the muscles of locomotion as well as to furnish skins of the rare forms.

### METHODS

All specimens were kept in plastic, waterproof bags to prevent drying until weighed at the field station. Small birds were weighed on a torsion balance of 120 grams capacity. Larger ones were weighed on Chatillon spring balances, the most sensitive one for the weight involved being used: 6,000 grams capacity with 24 grams sensitivity; 500 grams capacity with 10 grams sensitivity; and 250 grams capacity with 5 grams sensitivity. The adrenals and thyroids were carefully dissected free of extraneous tissue with the aid of a binocular loupe and promptly weighed on a Roller-Smith balance of either 30 mg. or 1,500 mg. capacity, depending upon the size of the specimen. The thoroughness of the dissection is extremely important because more or less extraneous tissue may adhere to the gland, especially the adrenal, thus contributing to the error. Only birds of healthy appearance were used. Most birds were collected between 0700 and 1100.

### RESULTS

Mean body weights and weights of adrenal and thyroid glands as percentages of body weights are given in the table. The number of individuals of each species is indicated in parentheses. Additional data on species in which the number of individuals is too small for inclusion in the table are listed in the text. Species are arranged according to Peters' Check-List (Peters, 1931-1951) or Eisenmann's List (Eisenmann, 1955).

### *Individual Variation*

There was great range among the individuals of many species in both adrenal and thyroid weights, perhaps more often in the adrenals than in the thyroids. It is this factor that makes it difficult to determine the typical mean unless a large series is available. However, some species do not show this wide range. These are: Anhinga, Snowy Egret, Cattle Egret, Least Bittern, Broad-winged Hawk, Barred Forest Falcon, Jacana, Scaled Pigeon, Smooth-billed Ani, Lineated Woodpecker, Red-crowned Woodpecker, Lineated Foliage-gleaner, Red-capped Manakin, Turquoise Cotinga, Bright-rumped Attila, Masked Tityra, Streaked Flycatcher, Yellow-rumped Cacique, White-lined Tanager, and Thick-billed Seed Finch.

### *Adrenals*

The adrenals are larger than the thyroids in 176 species, while the reverse is true in 42 species, the remainder being nearly the same. With a larger number of samples these values might change somewhat but never enough to reverse the picture. For representative species of each family, adrenal weights are plotted against body weight in Figure 1, the species starred in Table 1 being employed. It will be noted that the adrenal weights of birds weighing 200 grams or less are essentially a linear function of body weight, whereas larger birds show a great divergence, a few being below the line but more being above. The relatively largest adrenals were found in the Olivaceous Cormorant, Barred Forest Falcon, Scintillant Hummingbird, Green Kingfisher, Pygmy Kingfisher, Red-headed Barbet, Red-faced Spinetail, Bright-rumped Attila, Scale-crested Pygmy Tyrant, Yellow Tyrannulet, Rough-winged Swallow, Southern House Wren, Olive-backed Thrush, Scrub Greenlet, and Red-legged Honeycreeper.

In a few species the adrenals were relatively rather small. These were the American Jacana, some pigeons, Fiery-billed Araçari, *Momotus subrufescens*, Golden-olive Woodpecker, Lineated Woodpecker, Fasciated Antshrike, and Crested Oropendola.

No sex differences were noted, nor was a significant difference found in birds that were collected with an egg in the oviduct ready to be laid.

### *Thyroid*

Thyroid weights for representative members (the same species as for adrenals) of each family are plotted in Figure 2 as a function of body weight. Although the general trend is linear, unlike the adrenals, there is greater divergence all along the line, small species diverging as much as large ones.

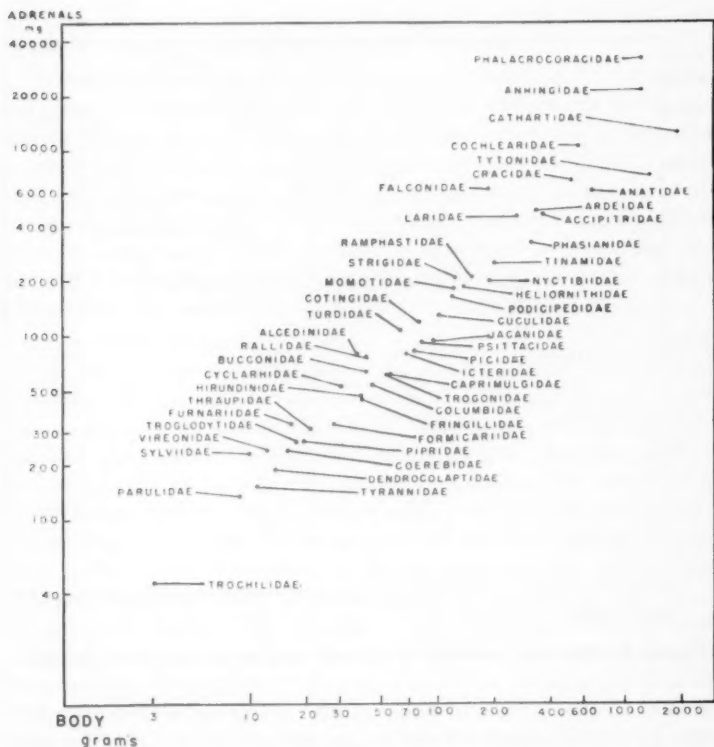


Figure 1. Selected plottings of adrenal weights against body weights.

The relatively largest thyroids were found in the Common Egret, Violet Sabrewing, Scintillant Hummingbird, Pale-breasted Spinetail, Rough-winged Swallow, White-throated Robin, Long-billed Gnatwren, Green Honeycreeper, Black-throated Green Warbler, Pileolated Warbler, Rose-breasted Grosbeak, and Yellow-faced Grassquit. The relatively smallest thyroids were obtained from the Anhinga, Broad-winged Hawk, Brown-hooded Parrot, Barn Owl, Common Potoo, Col-lared Araçari, and Golden-olive Woodpecker. Occasionally one thy-roid was much larger than the other, so much so that the smaller of the two appeared as a mere fragment. This difference appeared to be much less common in the adrenals.

Data from a number of species that appeared to differ in adrenal or thyroid size have been analyzed statistically, using Student's *t* test



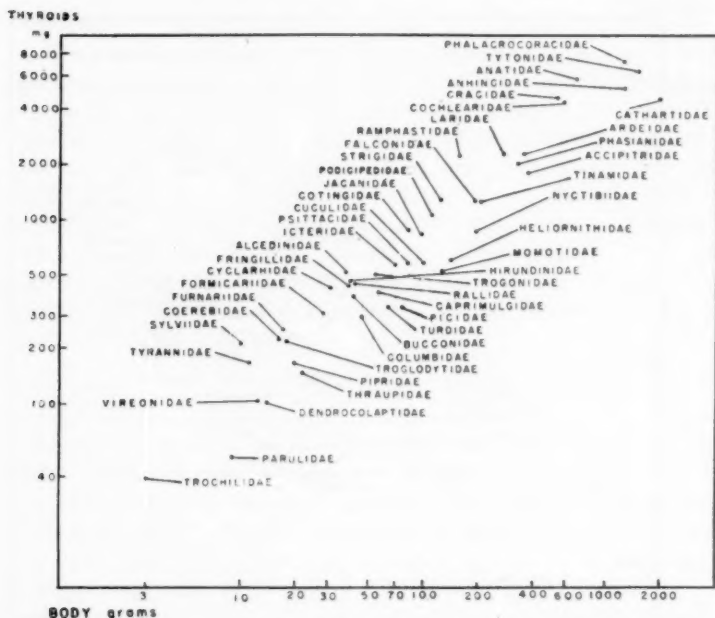


Figure 2. Selected plottings of thyroid weights against body weights.

(Student, 1908). The adrenals of the White-throated Crane were larger ( $P < 0.05$ ) than those of the Gray-necked Wood Rail. The adrenals of the Scaled Pigeon were smaller ( $P < 0.05$ ) than those of the Rufous-breasted Quail Dove. The adrenals of the Smooth-billed Ani were larger ( $P < 0.05$ ) than those of the Greater Ani. The adrenals of the Yellow-rumped Cacique were larger ( $P < 0.01$ ) than those of the Crested Oropendola. The adrenals of the Gray-breasted Martin ( $P < 0.05$ ) and the Spot-crowned Woodhewer ( $P < 0.01$ ) were smaller than those of the Red-legged Honeycreeper. The adrenals of the Common Bush-tanager were larger than those of the White-lined Tanager ( $P < 0.01$ ), Rose-breasted Thrush Tanager ( $P < 0.05$ ), Variable Seedeater ( $P < 0.01$ ), and the Thick-billed Seed-finch ( $P < 0.01$ ).

#### DISCUSSION

In this survey it should be noted that there was an absence of any manifestations of disease in the specimens included and that they were collected mostly in the morning hours during which they had been

feeding. This was also done at the time of the year when most of them were not breeding. A few were northern migrants.

In those species that show great individual variation, large numbers are required to demonstrate whether there are differences in the adrenals or thyroids due to sex, season, or climate. Latimer (1924) found no sex difference in the adrenals in an extensive study of White Leghorn chickens at different ages. Riddle (1925) reported an increase in the size of the adrenal of pigeons and doves at the time of ovulation. However, he used closely inbred strains in a controlled environment. Riddle (1927) also found that pigeon thyroids were largest in autumn and winter and smallest in the summer.

In an earlier paper by one of us (Hartman, 1946), data were reported for 79 species in 12 families that are not covered in this study. The range of variation for both adrenals and thyroids in some species was as great as we find in this study. Among all species included in this and the previous communication few showed great distinction in the relative size of the adrenals. None are relatively as large as those of the Brown Pelican, those of the Barred Forest Falcon being next in relative size. It is also interesting to note that the adrenals and thyroids in Panamá migrants from the United States showed no significant difference from the glands in the same species collected in the summer in the United States. This was true for the Black-and-White Warbler, the Black-throated Green Warbler, the Chestnut-sided Warbler, and the Rose-breasted Grosbeak. However, we do find differences in a few Panamá and Florida birds. The adrenals of the Olivaceous Cormorant were larger than those of the Double-crested Cormorant collected in Florida. The reverse was true for the thyroids. This inverse relationship between adrenal and thyroid weights brings to mind Harris' (1955) discussion of the reciprocal relation between thyroid and adrenal cortical secretion in mammals under the control of the anterior pituitary. As he points out, this occurs particularly in response to stressful situations when the adrenal secretory activity increases and that of the thyroid decreases. However, there was no evidence to indicate that the Olivaceous Cormorant group had been subjected to any greater stress than had Double-crested Cormorants. On the other hand, the thyroids were larger ( $P < 0.01$ ) in the Common Egret collected in Panamá compared with those in the same species from Florida.

That species of the same family may differ greatly in relative adrenal size is shown by the Snowy Egret in the Ardeidae, the White-throated Crake in the Rallidae, the Rufous-breasted Quail Dove in the

Columbidae, the Bright-rumped Attila in the Cotingidae, the Scale-crested Pygmy Tyrant and the Yellow Tyrannulet in the Tyrannidae, and the Rough-winged Swallow in the Hirundinidae.

This is also true for thyroids as shown by the Lesser Nighthawk in the Caprimulgidae, the Emerald Toucanet in the Ramphastidae, the Wedge-billed Woodhewer in the Dendrocolaptidae, Red-faced Spinetail in the Furnariidae, and the Rough-winged Swallow in the Hirundinidae.

The variation in relative thyroid size in some species is not surprising in light of Riddle's (1927) investigations in which he was able to establish races of ring doves characterized by large thyroids and other races by small thyroids. Riddle and Fisher (1925) found that seasonal change in thyroid size was greater in the common pigeon than in the ring dove. Thus under controlled environmental conditions the thyroids of some species are more susceptible to change than are others.

The question of the variable size of the thyroid and the adrenal is an interesting one. Variation in size of the thyroid is perhaps less important than variation in adrenal size because a small thyroid can meet extra demand better than can a small adrenal, since the thyroid can store considerable hormone while the adrenal depends more upon its immediate output. Although the two adrenals occasionally differ in size, this does not occur so often or so markedly as it does in the thyroids. Both are under the control of the anterior pituitary and the hypothalamus.

The variation in adrenal size in birds appears to be much greater than in mammals. Christian (1953) found that adrenal weight in mammals follows a definite logarithmic relationship to body size for a large number of mammalian species.

If adrenal and thyroid size reflect the metabolic activity of the organism, it should be shown among birds of different species, since they include some of the most active in the animal kingdom. However, such reflection does not occur. Hummingbirds possess adrenals and thyroids of very ordinary size, while cormorants and pelicans have very large adrenals and ordinary thyroids.

We must conclude that the relative sizes of the adrenals and thyroids, when comparing one species with another, bear no relation to the activity of the bird, since some of the most active species may have small glands or glands of only moderate size while those with the largest glands may not be unusually active. Even within the species there may be considerable variation among individuals. This, however, does not mean that external factors do not influence the size and activity of the glands, since they are controlled at least in part through the nervous system

via the hypothalamus. In order to prove such effect it would be necessary to employ a large series under standardized conditions.

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#### SUMMARY

Body weights and percentage adrenal and thyroid weights are recorded for 249 species of birds in 49 families, collected in Panamá during December, January, February, and March.

There was great range among individuals of many species in both adrenal and thyroid weights. However, this range was not great in 20 species.

The adrenals were larger than the thyroids in 176 species, while the reverse was true in 42 species.

When the logarithms of the adrenal weights are plotted against those of the body weight, the values of birds weighing 200 grams or less tend to lie near a straight line, while larger birds show a great divergence, a few being below the line but more being above. There were 15 species with adrenals about 0.02 per cent of the body weight or above. In eight species the adrenals were 0.01 per cent of the body weight or less.

When the logarithms of thyroid weights are plotted against those of the body weight, the general trend is a straight line, but, unlike the adrenals, there was a generally greater divergence, small birds showing as much divergence as large ones. There were 12 species with thyroids 0.015 per cent of the body weight or less. In seven species the thyroids were 0.005 per cent of the body weight or less.

Adrenals and thyroids of four species of migrants from the United States showed no difference from the same species collected in the United States.

The adrenals of the Olivaceous Cormorant were larger than those of the Double-crested Cormorant collected in Florida. The reverse was true for the thyroids. However, the thyroids of the Common Egret collected in Panamá were larger than those from the same species from Florida.

TABLE 1  
ARITHMETIC MEAN BODY WEIGHTS, PERCENTAGE ADRENAL AND PERCENTAGE  
THYROID OF BODY WEIGHTS WITH STANDARD ERROR OF THE MEANS  
(Number of individuals in parentheses)

Family and species	Mean body weight ± standard error grams	Adrenal weight × 100 Body weight ± standard error	Thyroid weight × 100 Body weight ± standard error
TINAMIDAE			
<i>Crypturellus soui</i> Little Tinamou	(3) 202 ± 13.2	(3) 0.0122 ± 0.0033 (0.0066 — 0.0154)**	(3) 0.0110 ± 0.0032 (0.0073 — 0.0164)
PODICIPEDIDAE			
<i>Podiceps dominicus</i> Least Grebe	(2) 105.3, 119.1	(2) 0.0133, 0.0159	(2) 0.0086, 0.0100
PHALACROCORACIDAE			
<i>Phalacrocorax olivaceus</i> Olivaceous Cormorant	(3) 1225 ± 64	(3) 0.0258 ± 0.0049 (0.0182 — 0.0318)	(3) 0.0063 ± 0.0011 (0.0049 — 0.0089)
ANHINGIDAE			
<i>Anhinga anhinga</i> Anhinga	(2) 1150, 1325	(2) 0.0176, 0.0170	0.0041
ARDEIDAE			
<i>Casmerodius albus</i> Common Egret	(4) 917 ± 44	(4) 0.0142 ± 0.0033 (0.0078 — 0.0219)	(4) 0.0056 ± 0.0010 (0.0029 — 0.0070)
<i>Leucophox thula</i> Snowy Egret	(6) 394 ± 24.3	(6) 0.0180 ± 0.0016 (0.0140 — 0.0240)	(6) 0.0059 ± 0.0007 (0.0037 — 0.0087)
* <i>Bubulcus ibis</i> Cattle Egret	(9) 339 ± 9.6	(9) 0.0138 ± 0.0010 (0.0108 — 0.0197)	(9) 0.0073 ± 0.0004 (0.0057 — 0.0095)
<i>Ixobrychus exilis</i> Least Bittern	(3) 87.7 ± 3.75	(3) 0.0171 ± 0.0020 (0.0138 — 0.0188)	(2) 0.0062, 0.0096

COCHLEARIIDAE				
<i>Cochlearius cochlearius</i>				(3) 0.0075 $\pm$ 0.0009 (0.0061 — 0.0085)
Boat-billed Heron	(3) 570 $\pm$ 6.1	(3) 0.0185 $\pm$ 0.0024 (0.0147 — 0.0217)		
ANATIDAE				
<i>Aythya affinis</i>				(†) 0.0086
Lesser Scaup	(2) 675; 675	0.0082, 0.0105		
CATHARTIDAE				
<i>Coragyps atratus</i>	(1) 1940	0.0065		0.0075
Black Vulture				
ACCIPITRIDAE				
<i>Buteo platypterus</i>	(4) 367 $\pm$ 14	(4) 0.0120 $\pm$ 0.0017 (0.0087 — 0.0156)		(4) 0.0049 $\pm$ 0.0010 (0.0025 — 0.0063)
Broad-winged Hawk				
FALCONIDAE				
<i>Micrastur ruficollis</i>	(5) 190 $\pm$ 8.73	(4) 0.0322 $\pm$ 0.0019 (0.0290 — 0.0366)		(5) 0.0066 $\pm$ 0.0005 (0.0057 — 0.0082)
Barred Forest Falcon				
CRACIDAE				
<i>Ortalis garrula</i>	(4) 537 $\pm$ 40	(4) 0.0128 $\pm$ 0.0023 (0.0079 — 0.0172)		(4) 0.0085 $\pm$ 0.0016 (0.0057 — 0.0111)
Chestnut-winged Chachalaca				
PHASIANIDAE				
* <i>Odontophorus guttatus</i>	(9) 323 $\pm$ 15	(8) 0.0094 $\pm$ 0.0012 (0.0058 — 0.0162)		(8) 0.0062 $\pm$ 0.0007 (0.0039 — 0.0089)
Spotted Wood Quail				
<i>Coturnix coturnix</i>	(3) 113 $\pm$ 4.3	(3) 0.0136 $\pm$ 0.0030 (0.0092 — 0.0180)		(2) 0.0050; 0.0063
Japanese Quail				
<i>Gallus gallus</i>	(9) 2330 $\pm$ 19	(9) 0.0073 $\pm$ 0.0009		(9) 0.0074 $\pm$ 0.0007
Common Fowl				
RALLIDAE				
<i>Aramides cajana</i>	(5) 429 $\pm$ 15.8	(4) 0.0102 $\pm$ 0.0015 (0.0079 — 0.0136)		(5) 0.0077 $\pm$ 0.0008 (0.0072 — 0.0085)
Gray-necked Wood Rail				

\* Representative of the family in the tables.

\*\* Range.

TABLE 1  
ARITHMETIC MEAN BODY WEIGHTS, PERCENTAGE ADRENAL AND PERCENTAGE  
THYROID OF BODY WEIGHTS WITH STANDARD ERROR OF THE MEANS  
(Number of individuals in parentheses)

Family and species	Mean body weight ± standard error grams	Adrenal weight $\times 100$ Body weight ± standard error	Thyroid weight $\times 100$ Body weight ± standard error
* <i>Laterallus albigularis</i> White-throated Crane	(6) 41.94 ± 3.40	(6) 0.0181 ± 0.0024 (0.0122 — 0.0284)	(6) 0.0108 ± 0.0014
HELIORNITHIDAE			
<i>Heliornis fulica</i> Sungrebe	(1) 140	0.0129	0.0114
JACANIDAE			
<i>Jacana spinosa</i> American Jacana	(6) 95.87 ± 9.8	(6) 0.0096 ± 0.0005 (0.0085 — 0.0109)	(6) 0.0086 ± 0.0016 (0.0053 — 0.0148)
LARIDAE			
<i>Larus pipiscan</i> Franklin's Gull	(3) 270 ± 24.7	(3) 0.0183 ± 0.0046 (0.0130 — 0.0257)	(3) 0.0083 ± 0.0014 (0.0066 — 0.0104)
COLUMBIDAE			
<i>Columba spectiosa</i> Scaled Pigeon	(3) 267 ± 15.4	(3) 0.0087 ± 0.0007 (0.0078 — 0.0098)	(3) 0.0069 ± 0.0012 (0.0049 — 0.0081)
<i>Columba albitinea</i> White-necked Pigeon	(3) 317 ± 7.8	(3) 0.0103 ± 0.0018 (0.0081 — 0.0131)	(3) 0.0105 ± 0.0030 (0.0071 — 0.0155)
* <i>Columbigallina talpacoti</i> Ruddy Ground Dove	(8) 45.58 ± 1.82	(8) 0.0119 ± 0.0029 (0.0054 — 0.0249)	(8) 0.0064 ± 0.00065 (0.0039 — 0.0088)
<i>Claravis pretiosa</i> Blue Ground Dove	(4) 70.7 ± 1.97	(3) 0.0113 ± 0.0016 (0.0086 — 0.0130)	(3) 0.0092 ± 0.0007 (0.0081 — 0.0100)
<i>Leptotila cassini</i> Gray-chested Dove	(3) 143 ± 14.35	(3) 0.0094 ± 0.0016 (0.0076 — 0.0120)	(3) 0.0081 ± 0.0003 (0.0076 — 0.0085)



<i>Leptotila rufinucha</i> Rufous-naped Dove	(3) 164 ± 7.57	(3) 0.0126 ± 0.0013 (0.0108 — 0.0142)	(3) 0.0114 ± 0.0019 (0.0087 — 0.0141)
<i>Geotrygon montana</i> Ruddy Quail Dove	(5) 136.3 ± 4.47	(4) 0.0087 ± 0.0023 (0.0043 — 0.0131)	(4) 0.0098 ± 0.0015 (0.0057 — 0.0117)
<i>Geotrygon chiriquiensis</i> Rufous-breasted Quail Dove	(5) 314 ± 8.52	(5) 0.0168 ± 0.0029 (0.0107 — 0.0239)	(5) 0.0081 ± 0.0004 (0.0071 — 0.0089)
PSITTACIDAE			
* <i>Pyrrhura hoffmanni</i> Sulphur-winged Parakeet	(6) 81.45 ± 2.84	(4) 0.0113 ± 0.0020 (0.0066 — 0.0148)	(5) 0.0071 ± 0.0007 (0.0058 — 0.0095)
<i>Brotheria jugularis</i> Orange-chinned Parakeet	(5) 64.79 ± 2.10	(5) 0.0151 ± 0.0018 (0.0101 — 0.0189)	(4) 0.0065 ± 0.0003 (0.0060 — 0.0070)
<i>Pipopsitta haematotis</i> Brown-hooded Parrot	(3) 145 ± 3.91	(3) 0.0131 ± 0.0021 (0.0114 — 0.0165)	(3) 0.0050 ± 0.0005 (0.0041 — 0.0056)
CUCULIDAE			
<i>Piaya cayana</i> Squirrel Cuckoo	(5) 103.5 ± 5.1	(5) 0.0130 ± 0.0017 (0.0086 — 0.0170)	(5) 0.0108 ± 0.0031 (0.0037 — 0.0181)
<i>Crotophaga major</i> Greater Ani	(5) 162 ± 2.09	(5) 0.0101 ± 0.0010 (0.0075 — 0.0134)	(5) 0.0058 ± 0.0006 (0.0045 — 0.0072)
* <i>Crotophaga ani</i> Smooth-billed Ani	(11) 100.56 ± 1.73	(10) 0.0128 ± 0.0007 (0.0051 — 0.0165)	(10) 0.0055 ± 0.0005 (0.0040 — 0.0091)
TYTONIDAE			
<i>Tyto alba</i> Barn Owl	1393	0.0125	0.0046
STRIGIDAE			
<i>Otus choliba</i> Tropical Screech Owl	(3) 124 ± 3.57	(3) 0.0168 ± 0.0023 (0.0147 — 0.0207)	(3) 0.0100 ± 0.0030 (0.0062 — 0.0147)
NYCTIBIDAE			
<i>Nyctibius grisescens</i> Common Potoo	(4) 191 ± 18.2	(4) 0.0102 ± 0.0020 (0.0075 — 0.0150)	(4) 0.0044 ± 0.0006 (0.0032 — 0.0055)

TABLE 1  
ARITHMETIC MEAN BODY WEIGHTS, PERCENTAGE ADRENAL AND PERCENTAGE  
THYROID OF BODY WEIGHTS WITH STANDARD ERROR OF THE MEANS  
(Number of individuals in parentheses)

Family and species	Mean body weight ± standard error grams	Adrenal weight × 100		Thyroid weight × 100	
		Body weight ± standard error		Body weight ± standard error	
CAPRIMULGIDAE					
<i>Chordeiles acutipennis</i> Lesser Nighthawk	(3) 51.78 ± 3.14	(3) 0.0127 ± 0.0020 (0.0099 — 0.0156)		(3) 0.0131 ± 0.0008 (0.0119 — 0.0138)	
* <i>Nyctidromus albigollis</i> Pauraque	(7) 56.43 ± 2.76	(6) 0.0120 ± 0.0015 (0.0091 — 0.0189)		(6) 0.0077 ± 0.0011 (0.0049 — 0.0102)	
TROCHILIDAE					
<i>Glaucis hirsuta</i> Rufous-breasted Hermit	(5) 6.19 ± 0.23	(5) 0.0123 ± 0.0012 (0.0100 — 0.0150)		(4) 0.0137 ± 0.0010 (0.0120 — 0.0157)	
<i>Phaethroa cuculii</i> Scaly-breasted Hummingbird	(6) 8.72 ± 0.22	(6) 0.0137 ± 0.0022 (0.0111 — 0.0158)		(4) 0.0093 ± 0.0015 (0.0067 — 0.0119)	
<i>Campylopterus hemileucurus</i> Violet Sabrewing	(6) 11.18 ± 0.46	(6) 0.0152 ± 0.0027 (0.0114 — 0.0277)		(4) 0.0181 ± 0.0076 (0.0059 — 0.0342)	
* <i>Danophila julie</i> Violet-bellied Hummingbird	(10) 3.05 ± 0.05	(6) 0.0151 ± 0.0018 (0.0106 — 0.0213)		(8) 0.0127 ± 0.0010 (0.0089 — 0.0177)	
<i>Amazilia edward</i> Snowy-breasted Hummingbird	(4) 4.74 ± 0.09	(3) 0.0131 ± 0.0036 (0.0074 — 0.0172)		(4) 0.0128 ± 0.0021 (0.0082 — 0.0168)	
<i>Amazilia tzacatl</i> Rufous-tailed Hummingbird	(8) 4.98 ± 0.0005	(8) 0.0110 ± 0.0015 (0.0064 — 0.0166)		(7) 0.0125 ± 0.0020 (0.0079 — 0.0229)	
<i>Lampornis castaneiventris</i> White-throated Mountain-Gem	(5) 5.66 ± 0.34	(5) 0.0134 ± 0.0019 (0.0094 — 0.0173)		(3) 0.0078 ± 0.0017 (0.0080 — 0.0106)	
<i>Sceloporus scintilla</i> Scintillant Hummingbird	(4) 2.16 ± 0.09	(4) 0.0202 ± 0.0084 (0.0109 — 0.0420)		(2) 0.0222 ± 0.0227	

TROGONIDAE			
<i>Trogon massaena</i> Slaty-tailed Trogon	(3) 150.3 ± 1.39	(3) 0.0099 ± 0.0007 (0.0089 — 0.0108)	(3) 0.0068 ± 0.0003 (0.0062 — 0.0078)
<i>Trogon rufus</i> Black-throated Trogon	(3) 52.8 ± 3.74	(3) 0.0148 ± 0.0030 (0.0122 — 0.0190)	(3) 0.0146 ± 0.0024 (0.0110 — 0.0180)
* <i>Trogon violaceus</i> Violaceous Trogon	(4) 54.2 ± 1.61	(4) 0.0115 ± 0.0017 (0.0079 — 0.0147)	(4) 0.0111 ± 0.0009 (0.0096 — 0.0133)
ALCEDINIDAE			
<i>Chloroceryle amazona</i> Amazon Kingfisher	(6) 121.9 ± 3.82	(6) 0.0172 ± 0.0031 (0.0082 — 0.0292)	(6) 0.0074 ± 0.0011 (0.0058 — 0.0086)
* <i>Chloroceryle americana</i> Green Kingfisher	(8) 37.74 ± 2.58	(6) 0.0209 ± 0.0029 (0.0141 — 0.0300)	(6) 0.0136 ± 0.0033 (0.0066 — 0.0252)
<i>Chloroceryle alexa</i> Pygmy Kingfisher	(3) 15.84 ± 0.59	(3) 0.0194 ± 0.0027 (0.0170 — 0.0238)	(3) 0.0108 ± 0.0012 (0.0089 — 0.0119)
MOMOTIDAE			
<i>Momotus subrufescens</i> Tawny-bellied Motmot	(3) 103.9 ± 3.23	(3) 0.0077 ± 0.0018 (0.0050 — 0.0107)	(3) 0.0073 ± 0.0011 (0.0058 — 0.0090)
* <i>Momotus momota</i> Blue-crowned Motmot	(3) 125.9 ± 2.27	(3) 0.0141 ± 0.0020 (0.0108 — 0.0160)	(3) 0.0073 ± 0.0007 (0.0063 — 0.0082)
BUCCONIDAE			
<i>Malacoptila panamensis</i> White-whiskered Puffbird	(2) 41.2; 43.0	(2) 0.0160; 0.0149	(2) 0.0083; 0.0095
CAPITONIDAE			
<i>Eubucco bourcierii</i> Red-headed Barbet	(6) 33.6 ± 1.52	(6) 0.0187 ± 0.0024 (0.0141 — 0.0229)	(5) 0.0091 ± 0.0012 (0.0060 — 0.0125)
RAMPHASTIDAE			
* <i>Aulacorhynchus prasinus</i> Emerald Toucanet	(5) 153.5 ± 3.60	(4) 0.0135 ± 0.0025 (0.0092 — 0.0171)	(5) 0.0141 ± 0.0024 (0.0092 — 0.0200)
<i>Pteroglossus torquatus</i> Collared Aracari	(3) 237 ± 8	(3) 0.0120 ± 0.0012 (0.0103 — 0.0138)	(3) 0.0049 ± 0.0004 (0.0044 — 0.0056)

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Family and species	Mean body weight ± standard error grams	Adrenal weight × 100 Body weight ± standard error	Thyroid weight × 100 Body weight ± standard error
<i>Pterodromas frontalis</i> Fiery-billed Araçari	(3) 276 ± 4.21	(3) 0.0105 ± 0.0007 (0.0096 — 0.0116)	(3) 0.0052 ± 0.0008 (0.0038 — 0.0060)
PICIDAE			
* <i>Piculus rubiginosus</i> Golden-olive Woodpecker	(4) 77.3 ± 2.81	(3) 0.0107 ± 0.0010 (0.0096 — 0.0122)	(3) 0.0043 ± 0.0004 (0.0038 — 0.0049)
<i>Dryocopus lineatus</i> Lineated Woodpecker	(6) 184.7 ± 4.2	(5) 0.0090 ± 0.0003 (0.0081 — 0.0098)	(5) 0.0053 ± 0.0008 (0.0038 — 0.0069)
<i>Centurus rubricapillus</i> Red-crowned Woodpecker	(3) 51.07 ± 2.35	(3) 0.0140 ± 0.0008 (0.0130 — 0.0152)	(3) 0.0084 ± 0.0006 (0.0074 — 0.0091)
<i>Centurus pucherani</i> Black-cheeked Woodpecker	(4) 56.9 ± 3.19	(3) 0.0107 ± 0.0015 (0.0082 — 0.0125)	(3) 0.0069 ± 0.0020 (0.0050 — 0.0101)
<i>Dendrocopos villosus</i> Hairy Woodpecker	(3) 40.7 ± 1.39	(3) 0.0114 ± 0.0021 (0.0094 — 0.0151)	(2) 0.0082 ± 0.0103
DENDROCOLAPTIDAE			
* <i>Sittasomus griseicapillus</i> Olivaceous Woodhewer	(7) 13.92 ± 0.33	(5) 0.0135 ± 0.0031 (0.0073 — 0.0230)	(5) 0.0072 ± 0.0011 (0.0052 — 0.0100)
<i>Glyphorhynchus spirurus</i> Wedge-billed Woodhewer	(3) 13.03 ± 1.44	(3) 0.0140 ± 0.0016 (0.0127 — 0.0166)	(3) 0.0133 ± 0.0008 (0.0120 — 0.0140)
<i>Xiphorhynchus erythropygius</i> Spotted Woodhewer	(5) 48.5 ± 1.67	(5) 0.0115 ± 0.0022 (0.0073 — 0.0178)	(5) 0.0067 ± 0.0022 (0.0041 — 0.0144)
<i>Lepidocolaptes affinis</i> Spot-crowned Woodhewer	(4) 33.62 ± 1.84	(5) 0.0119 ± 0.0015 (0.0076 — 0.0150)	(4) 0.0073 ± 0.0009 (0.0054 — 0.0087)

<b>FURNARIIDAE</b>			
<i>Synallaxis albescentis</i>			(2) 0.0175 ± 0.0285
Pale-breasted Spinetail	(3) 13.35 ± 0.27	(3) 0.0167 ± 0.0045 (0.0093 — 0.207)	(2) 0.0087 ± 0.0165
<i>Synallaxis brachyura</i>	(4) 18.14 ± 0.38	(3) 0.0164 ± 0.0042 (0.0093 — 0.0231)	(5) 0.0148 ± 0.0027 (0.0088 — 0.0228)
* <i>Cranioleuca erythrops</i>	(7) 16.94 ± 0.21	(6) 0.0191 ± 0.0022 (0.0138 — 0.0265)	(4) 0.0065 ± 0.0006 (0.0055 — 0.0074)
Red-faced Spinetail	(4) 31.28 ± 3.23	(4) 0.0116 ± 0.0007 (0.0102 — 0.0127)	(3) 0.0080 ± 0.0032 (0.0039 — 0.0130)
<i>Syndactyla subularis</i>		(3) 0.0151 ± 0.0038 (0.0090 — 0.0194)	(3) 0.0091 ± 0.0019 (0.0073 — 0.0122)
Linedated Foliage-gleaner	(4) 25.0 ± 3.54	(3) 0.0086 ± 0.0008 (0.0081 — 0.0099)	(6) 0.0085 ± 0.0012 (0.0052 — 0.0129)
Scaly-throated Foliage-gleaner		(4) 0.0127 ± 0.0018 (0.0103 — 0.0173)	(5) 0.0090 ± 0.0016 (0.0060 — 0.0145)
<b>FORMICARIIDAE</b>			
<i>Cymbilaimus lineatus</i>	(3) 35.85 ± 0.71	(5) 0.0162 ± 0.0023 (0.0099 — 0.0276)	(6) 0.0093 ± 0.0016 (0.0058 — 0.0143)
Fasciated Antshrike	(6) 28.05 ± 0.52	(3) 0.0143 ± 0.0031 (0.0095 — 0.0182)	(3) 0.0104 ± 0.0022 (0.0065 — 0.0126)
<i>Thamnophilus dolius</i>		(5) 0.0127 ± 0.0029 (0.0058 — 0.0193)	(4) 0.0109 ± 0.0021 (0.0060 — 0.0100)
Barred Antshrike	(6) 14.31 ± 0.45	(5) 0.0144 ± 0.0008 (0.0125 — 0.0165)	(4) 0.0088 ± 0.0015 (0.0056 — 0.0121)
<i>Dysithamnus mentalis</i>	(5) 16.18 ± 0.41	(6) 0.038 ± 0.0011 (0.0109 — 0.0178)	(8) 0.0086 ± 0.0006 (0.0068 — 0.0119)
Plain Antvireo			
<i>Cercomacra tyrannina</i>	(3) 61.6 ± 1.40		
Dusky Antbird	(5) 28.38 ± 1.52		
<i>Formicarius analis</i>			
Black-faced Antthrush			
* <i>Gymnophthalmus bicolor</i>			
Bicolored Antbird			
<b>PIPRIDAE</b>			
<i>Pipra mentalis</i>	(5) 15.06 ± 0.47		
Red-capped Manakin			
* <i>Manacus vitellinus</i>	(8) 19.29 ± 0.53		
Golden-collared Manakin			

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COTINGIDAE			
<i>Cotinga ridgwayi</i>	(4) 57.8 ± 1.67	(4) 0.0141 ± 0.0010 (0.0098 — 0.0167)	(3) 0.0099 ± 0.0006 (0.0085 — 0.0106)
Turquoise Cotinga	(5) 40.4 ± 0.73	(5) 0.0215 ± 0.0013 (0.0129 — 0.0258)	(5) 0.0083 ± 0.0008 (0.0075 — 0.0113)
<i>Attila spadiceus</i>	(3) 38.0 ± 0.31	(2) 0.0117, 0.0172	(3) 0.0060 ± 0.0008 (0.0044 — 0.0077)
Bright-rumped Attila	(10) 80.14 ± 0.79	(8) 0.0146 ± 0.0008 (0.0099 — 0.0239)	(10) 0.0109 ± 0.0006 (0.0055 — 0.0229)
<i>Rhytipterna holerythra</i>	(4) 41.6 ± 1.24	(4) 0.0156 ± 0.0024 (0.0078 — 0.0247)	(4) 0.0111 ± 0.0015 (0.0077 — 0.0178)
Rufous Mourner	(5) 100.97 ± 1.37	(5) 0.0113 ± 0.0028 (0.0098 — 0.0151)	(5) 0.0078 ± 0.0007
* <i>Tityra semifasciata</i>			
Masked Tityra			
<i>Erator inquisitor</i>			
Black-crowned Tityra			
<i>Querula purpurata</i>			
Purple-throated Fruitcrow			
TYRANNIDAE			
<i>Myiodynastes maculatus</i>	(6) 46.48 ± 0.52	(6) 0.0132 ± 0.0007 (0.0090 — 0.0174)	(4) 0.0102 ± 0.0010 (0.0079 — 0.0146)
Streaked Flycatcher	(3) 74.8 ± 2.93	(3) 0.0123 ± 0.0012 (0.0096 — 0.0138)	(2) 0.0105, 0.0141
<i>Megarynchus pitangua</i>			
Boat-billed Flycatcher	(3) 27.1 ± 1.83	(2) 0.0068, 0.0092	(3) 0.0144 ± 0.0004 (0.0082 — 0.0208)
<i>Myiozetetes similis</i>			
Social Flycatcher	(4) 18.81 ± 0.65	(3) 0.0124 ± 0.0018 (0.0102 — 0.0152)	(4) 0.0128 ± 0.0026 (0.0093 — 0.0195)
<i>Myiarchus tuberculifer</i>			
Dusky-capped Flycatcher			

* <i>Empidonax flaviventris</i> Yellow-bellied Flycatcher	(8) 10.98 ± 0.32	(7) 0.0138 ± 0.0021 (0.0073 — 0.0219)	(8) 0.0149 ± 0.0018 (0.0087 — 0.0237)
<i>Empidonax flavescens</i> Yellowish Flycatcher	(4) 12.26 ± 0.38	(3) 0.0151 ± 0.0037 (0.0093 — 0.0197)	(4) 0.0108 ± 0.0010 (0.0096 — 0.0126)
<i>Mitrephanes phaeocercus</i> Tufted Flycatcher	(3) 8.83 ± 0.24	(3) 0.0131 ± 0.0021 (0.0096 — 0.0151)	(2) 0.0039, 0.0085
<i>Lophotriccus plicatus</i> Scale-crested Pygmy-Tyrant	(6) 7.85 ± 0.22	(4) 0.0222 ± 0.0058 (0.0141 — 0.0350)	(5) 0.0145 ± 0.0036 (0.0069 — 0.0253)
<i>Capsiempis flaveola</i> Yellow Tyrannulet	(3) 7.16 ± 0.22	(3) 0.0236 ± 0.0067 (0.0135 — 0.0325)	(2) 0.0107, 0.0184
<i>Elaenia frantzii</i> Mountain Elaenia	(7) 20.5 ± 0.52	(6) 0.0137 ± 0.0019 (0.0102 — 0.0205)	(7) 0.0097 ± 0.0009 (0.0065 — 0.0139)
<i>Myiopagis viridicula</i> Greenish Elaenia	(3) 14.23 ± 0.66	(2) 0.0135, 0.0178	(3) 0.0099 ± 0.0034 (0.0043 — 0.0138)
<i>Tyranniscus villosissimus</i> Palmy Tyrannulet	(3) 8.75 ± 0.30	(3) 0.0089 ± 0.0026 (0.0054 — 0.0125)	(3) 0.0097 ± 0.0009 (0.0087 — 0.0112)
HIRUNDINIDAE			
* <i>Progne chalybea</i> Gray-breasted Martin	(11) 39.42 ± 0.93	(10) 0.0118 ± 0.0030 (0.0070 — 0.0177)	(9) 0.0116 ± 0.0006 (0.0090 — 0.0140)
<i>Stelgidopteryx ruficollis</i> Rough-winged Swallow	(3) 12.06 ± 0.54	(3) 0.0206 ± 0.0050 (0.0130 — 0.0269)	(3) 0.0163 ± 0.0009 (0.0149 — 0.0173)
TROGLODYTIDAE			
<i>Thryothorus modestus</i> Plain Wren	(5) 19.06 ± 0.42	(5) 0.0166 ± 0.0023 (0.0129 — 0.0242)	(4) 0.0084 ± 0.0014 (0.0048 — 0.0107)
<i>Troglodytes musculus</i> Southern House Wren	(6) 14.67 ± 3.75	(6) 0.0194 ± 0.0013 (0.0161 — 0.0225)	(5) 0.0139 ± 0.0033 (0.0059 — 0.0230)
* <i>Henicorhina leucophrys</i> Gray-breasted Wood Wren	(5) 17.64 ± 0.29	(5) 0.0147 ± 0.0019 (0.0090 — 0.0184)	(4) 0.0117 ± 0.0027 (0.0079 — 0.0186)



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<i>Cyphorhinus phaeocephalus</i> Song Wren	(3) 27.47 ± 1.02	(3) 0.0109 ± 0.0017 (0.0082 — 0.0132)	(2) 0.0058, 0.0080
TURDIDAE			
* <i>Turdus assimilis</i> White-throated Robin	(3) 64.1 ± 1.09	(3) 0.0166 ± 0.0055 (0.0143 — 0.0200)	(3) 0.0207 ± 0.0054 (0.0139 — 0.0291)
<i>Turdus grayi</i> Clay-colored Robin	(3) 72.3 ± 1.27	(3) 0.0139 ± 0.0014 (0.0121 — 0.0161)	(3) 0.0128 ± 0.0044 (0.0079 — 0.0198)
<i>Hylodichla ustulata</i> Olive-backed Thrush	(4) 31.1 ± 0.35	(4) 0.0212 ± 0.0067 (0.0148 — 0.0386)	(4) 0.0106 ± 0.0015 (0.0074 — 0.0128)
SYLVIIDAE			
<i>Ramphocaenus rufiventris</i> Long-billed Gnatwren	10.08	0.0231	0.0208
CYCLARHIDAE			
<i>Cyclarhis guianensis</i> Rufous-browed Peppershrike	(6) 30.97 ± 0.73	(6) 0.0165 ± 0.0018 (0.0123 — 0.0220)	(5) 0.0133 ± 0.0030 (0.0079 — 0.0235)
VIREONIDAE			
* <i>Hylophilus viridiflaeus</i> Scrub Greenlet	(3) 12.42 ± 0.31	(3) 0.0192 ± 0.0019 (0.0163 — 0.0220)	(2) 0.0059, 0.0113
<i>Hylophilus decurtatus</i> Gray-headed Greenlet	(3) 9.11 ± 0.19	(2) 0.0146, 0.0158	(3) 0.0119 ± 0.0033 (0.0092 — 0.0173)
COEREBOIDAE			
<i>Chlorophanes spiza</i> Green Honeycreeper	(3) 16.86 ± 0.26	(2) 0.0122, 0.0165	(3) 0.0151 ± 0.0057 (0.0075 — 0.0258)

<i>Cyanerpes cyaneus</i>	(8) 12.75 ± 0.47	(8) 0.0213 ± 0.0025 (0.0123 — 0.0286)	(7) 0.0096 ± 0.0038 (0.0059 — 0.0146)
Red-legged Honeycreeper			
<i>Cyanerpes lucidus</i>	(5) 11.40 ± 0.22	(4) 0.0156 ± 0.0018 (0.0134 — 0.0202)	(4) 0.0144 ± 0.0026 (0.0089 — 0.0202)
Shining Honeycreeper			
* <i>Dacnis venusta</i>	(5) 16.02 ± 0.63	(5) 0.0148 ± 0.0027 (0.0084 — 0.0203)	(5) 0.0138 ± 0.0023 (0.0076 — 0.0196)
Scarlet-thighed Dacnis			
PARULIDAE			
<i>Mniotilta varia</i>	(3) 9.58 ± 0.19	(2) 0.0094, 0.0213	(3) 0.0092 ± 0.0025 (0.0054 — 0.0126)
Black-and-White Warbler			
<i>Vermicora peregrina</i>	(5) 8.95 ± 0.22	(5) 0.0176 ± 0.0034 (0.0136 — 0.0207)	(5) 0.0101 ± 0.0017 (0.0066 — 0.0141)
Tennessee Warbler			
<i>Parula pitagorumi</i>	(4) 6.96 ± 0.15	(4) 0.0137 ± 0.0016 (0.0110 — 0.0166)	(2) 0.0110, 0.0155
Tropical Parula			
<i>Dendroica virens</i>	(6) 8.82 ± 0.14	(3) 0.0131 ± 0.0032 (0.0086 — 0.0163)	(3) 0.0155 ± 0.0043 (0.0112 — 0.0225)
Black-throated Green Warbler			
<i>Dendroica pensylvanica</i>	(3) 8.84 ± 0.089	(3) 0.0173 ± 0.0038 (0.0111 — 0.0214)	(3) 0.0085 ± 0.0014 (0.0072 — 0.0109)
Chestnut-sided Warbler			
<i>Wilsonia pusilla</i>	(5) 7.02 ± 0.177	(6) 0.0153 ± 0.0020 (0.0105 — 0.0231)	(6) 0.0161 ± 0.0037 (0.0126 — 0.0231)
Pileolated Warbler			
* <i>Myioborus miniatus</i>	(6) 9.01 ± 0.41	(5) 0.0148 ± 0.0019 (0.0101 — 0.0193)	(3) 0.0056 ± 0.0018 (0.0028 — 0.0075)
Slate-throated Redstart			
<i>Myioborus torquatus</i>	(4) 10.49 ± 0.26	(4) 0.0167 ± 0.0020 (0.0135 — 0.0215)	(4) 0.0079 ± 0.0019 (0.0055 — 0.0117)
Collared Redstart			
* <i>Basileuterus culicivorus</i>	(3) 10.8 ± 0.45	(2) 0.0153, 0.0241	(3) 0.0079 ± 0.0017 (0.0053 — 0.0100)
Golden-crowned Warbler			
ICTERIDAE			
<i>Zarhynchus wagleri</i>	♀ 110.5; 120	(4) 0.0105 ± 0.0017 (0.0092 — 0.0115)	(4) 0.0083 ± 0.0011 (0.0061 — 0.0108)
Chestnut-headed Oropendola	♂ 200.0; 225		

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<i>Psarocolius decumanus</i> Crested Oropendula	(3) 276 ± 42.5	(3) 0.0077 ± 0.0007 (0.0068 — 0.0083)	(3) 0.0074 ± 0.0003 (0.0071 — 0.0079)
* <i>Cacicus vitellinus</i> Yellow-rumped Cacique	(6) 68.77 ± 1.24	(7) 0.0115 ± 0.0007 (0.0093 — 0.0140)	(7) 0.0083 ± 0.0010 (0.0059 — 0.0111)
<i>Cacicus microhynchus</i> Scarlet-rumped Cacique	(4) 58.90 ± 4.11	(4) 0.0115 ± 0.0016 (0.0089 — 0.0152)	(4) 0.0067 ± 0.0016 (0.0043 — 0.0104)
<i>Amblycercus holosericeus</i> Yellow-billed Cacique	(3) 75.43 ± 1.93	(3) 0.0107 ± 0.0010 (0.0095 — 0.0122)	(2) 0.0054, 0.0062
<i>Scaphidura orizyivora</i> Colombian Rice Grackle	2 ♀ 132.60; 149.44 2 ♂ 175.3; 200	(4) 0.0119 ± 0.0013 (0.0071 — 0.0125)	(4) 0.0073 ± 0.0015 (0.0066 — 0.0086)
THRAUPIDAE			
* <i>Tangara icterocephala</i> Silver-throated Tanager	(6) 21.82 ± 0.63	(6) 0.0139 ± 0.0014 (0.0098 — 0.0181)	(5) 0.0066 ± 0.0009 (0.0048 — 0.0092)
<i>Tangara larvata</i> Golden-masked Tanager	(5) 19.42 ± 0.47	(5) 0.0168 ± 0.0021 (0.0110 — 0.0215)	(5) 0.0084 ± 0.0011 (0.0057 — 0.0111)
<i>Tangara gyrola</i> Bay-headed Tanager	(3) 22.3 ± 1.04	(3) 0.0140 ± 0.0027 (0.0106 — 0.0183)	(2) 0.0076, 0.0081
<i>Ramphocelus dimidiatus</i> Crimson-backed Tanager	(4) 31.28 ± 1.68	(4) 0.0131 ± 0.0030 (0.0059 — 0.0186)	(4) 0.0096 ± 0.0014 (0.0074 — 0.0127)
<i>Piranga rubra</i> Summer Tanager	(6) 30.22 ± 0.46	(4) 0.0121 ± 0.0023 (0.0057 — 0.0201)	(5) 0.0127 ± 0.0020 (0.0088 — 0.0219)

<i>Piranga leucoptera</i> White-winged Tanager	(4) 16.8 ± 0.74	(4) 0.0180 ± 0.0036 (0.0111 — 0.0234)	0.0095, 0.0095
<i>Habia fuscicauda</i> Dusky-tailed Ant-Tanager	(3) 39.34 ± 1.27	(3) 0.0137 ± 0.0027 (0.0104 — 0.0180)	(3) 0.0094 ± 0.0013 (0.0079 — 0.0114)
<i>Tachyphonus rufus</i> White-lined Tanager	(4) 34.95 ± 1.09	(4) 0.0093 ± 0.0006 (0.0081 — 0.0105)	(4) 0.0090 ± 0.0007 (0.0073 — 0.0103)
<i>Rhodinocichla rosea</i> Rose-breasted Thrush-Tanager	(3) 49.84 ± 1.00	(3) 0.0089 ± 0.0021 (0.0054 — 0.0116)	(3) 0.0062 ± 0.0014 (0.0051 — 0.0087)
<i>Chlorospingus ophthalmicus</i> Common Bush-Tanager	(6) 20.52 ± 0.75	(6) 0.0164 ± 0.0011 (0.0132 — 0.0210)	(3) 0.0081 ± 0.0027 (0.0039 — 0.0113)
FRINGILLIDAE			
<i>Salpator maximus</i> Buff-throated Saltator	(6) 48.2 ± 1.04	(4) 0.0128 ± 0.0054 (0.0103 — 0.0165)	(5) 0.0099 ± 0.0019 (0.0059 — 0.0145)
* <i>Salpator albicollis</i> Streaked Saltator	(7) 38.96 ± 1.00	(4) 0.0116 ± 0.0019 (0.0092 — 0.0166)	(5) 0.0111 ± 0.0021 (0.0083 — 0.0180)
<i>Phencticus ludovicianus</i> Rose-breasted Grosbeak	(4) 45.3 ± 0.97	(3) 0.0125 ± 0.0040 (0.0059 — 0.0162)	(3) 0.0168 ± 0.0037 (0.0105 — 0.0200)
<i>Tiaris olivacea</i> Yellow-faced Grassquit	(4) 8.46 ± 0.22	(4) 0.0123 ± 0.0026 (0.0117 — 0.0128)	(3) 0.0220 ± 0.0069 (0.0124 — 0.0322)
<i>Sporophila aurita</i> Variable Seed-eater	(6) 10.71 ± 1.63	(5) 0.0096 ± 0.0016 (0.0043 — 0.0123)	(6) 0.0122 ± 0.0039 (0.0081 — 0.0158)
<i>Oryzoborus limerus</i> Thick-billed Seed-Finch	(4) 12.48 ± 0.81	(4) 0.0086 ± 0.0010 (0.0071 — 0.0111)	(3) 0.0089 ± 0.0005 (0.0081 — 0.0095)
<i>Pselliophorus tibialis</i> Yellow-thighed Finch	(3) 33.0 ± 1.51	(3) 0.0181 ± 0.0032 (0.0130 — 0.0218)	(3) 0.0081 ± 0.0007 (0.0069 — 0.0090)
<i>Arremonops conirostris</i> Lafresnaye's Sparrow	(6) 40.80 ± 1.00	(3) 0.0103 ± 0.0020 (0.0070 — 0.0127)	(6) 0.0082 ± 0.0007 (0.0057 — 0.0103)
<i>Zonotrichia capensis</i> Rufous-collared Sparrow	(4) 20.03 ± 0.88	(4) 0.0161 ± 0.0026 (0.0110 — 0.0218)	(3) 0.0139 ± 0.0028 (0.0099 — 0.0179)

## SPECIES NOT SHOWN IN THE TABLES

## ANATIDAE

1 *Anas discors* (Blue-winged Teal): body, 330 g.; adrenals, 0.0094%; thyroids, 0.0076%. 1 *Mareca americana* (Baldpate): body, 545 g.; adrenals, 0.0224%; thyroids, 0.0112%.

## ACCIPITRIDAE

1 *Leptodon cayanensis* (Gray-headed Kite): body, 435 g.; adrenals, 0.0122%; thyroids, 0.0045%. 1 *Harpagus bidentatus* (Double-toothed Kite): body, 206 g.; adrenals, 0.0073%; thyroids, 0.0150%. 2 *Buteo magnirostris* (Large-billed Hawk): body, 295–312 g.; adrenals, 0.0131–0.0160%; thyroids, 0.0051%.

## COLUMBIDAE

1 *Leptotila verreauxi* (White-tipped Dove): body, 152 g.; adrenals, 0.0091%; thyroids, 0.0112%.

## PSITTACIDAE

2 *Bolborhynchus lincolna* (Barred Parakeet): body, 45.2–53.2 g.; adrenals, 0.0110–0.0185%; thyroids, 0.0077–0.0112%. 1 *Pionus senilis* (White-crowned Parrot): body, 165.6 g.; adrenals, 0.0157%; thyroids, 0.0080%. 2 *Amazona autumnalis* (Red-fronted Parrot): body, 400–468 g.; adrenals, 0.0094–0.0143%; thyroids, 0.0073–0.0094%.

## CUCULIDAE

1 *Coccyzus americanus* (Yellow-billed Cuckoo): body 52.4 g.; adrenals, 0.0094%; thyroids, 0.0079%. 2 *Tapera naevia* (Striped Cuckoo): body, 46.86–58.18 g.; adrenals, 0.0107–0.0196%; thyroids, 0.0080–0.0087%.

## STRIGIDAE

1 *Ciccaba nigrolineata* (Black-and-White Owl): body, 500 g.; adrenals, 0.0078%; thyroids, 0.0046%. 1 *Rhinoptynx clamator* (Striped Owl): body, 385 g.; adrenals, 0.0097%; thyroids, 0.0038%.

## TROCHILIDAE

2 *Phaethornis guy* (Green Hermit): body, 5.74–5.98 g.; adrenals, 0.0077–0.0124%; thyroids, 0.0094%. 2 *Phaethornis longuemareus* (Little Hermit): body, 2.71–2.77 g.; adrenals, 0.0134–0.0211%; thyroids, 0.0144–0.0166%. 2 *Anthracothonax nigricollis* (Black-throated Mango): body, 6.32–7.16 g.; adrenals, 0.0117–0.0160%; thyroids, 0.0064–0.0149%. 1 *Chlorostilbon assimilis* (Garden Emerald): body, 2.84 g.; adrenals, 0.0222%; thyroids, 0.0141%. 2 *Amazilia amabilis* (Blue-chested Hummingbird): body, 3.51–3.51 g.; adrenals, 0.0128–0.0251%; thyroids, 0.0185%. 2 *Eupherusa eximia* (Stripe-tailed Hummingbird): body, 4.29–4.50 g.; adrenals, 0.0142–0.0196%; thyroids, 0.0129–0.0191%. 2 *Elvira chionura* (White-tailed Emerald): body, 3.20–3.37 g.; adrenals, 0.0156%; thyroids, 0.0089–0.0199%. 2 *Heliothrix barroti* (Purple-crowned Fairy): body, 5.83–5.91 g.; adrenals, 0.0144–0.0146%; thyroids, 0.0164%. 1 *Philodice bryantae* (Magenta-throated Woodstar): body, 3.31 g.; adrenals, 0.0103%; thyroids, 0.0157%.

#### TROGONIDAE

2 *Pharomachrus mocinno* (Quetzal): body, 209–224 g.; adrenals, 0.0120–0.0125%; thyroids, 0.0071–0.0110%. 2 *Trogon strigilatus* (White-tailed Trogon): body, 62.4–63.7 g.; adrenals, 0.0159–0.0188%; thyroids, 0.0082–0.0114%. 2 *Trogon collaris* (Bar-tailed Trogon): body, 64.9–67.3 g.; adrenals, 0.0128–0.0145%; thyroids, 0.0089–0.0131%.

#### ALCEDINIDAE

1 *Ceryle torquata* (Ringed Kingfisher): body, 342 g.; adrenals, 0.0220%; thyroids, 0.0074%.

#### RAMPHASTIDAE

1 *Ramphastos swainsonii* (Chestnut-mandibled Toucan): body, 600 g.; adrenals, 0.0102%; thyroids, 0.0160%.

#### PICIDAE

2 *Picumnus olivaceus* (Olivaceous Piculet): body, 10.78–10.93 g.; adrenals, 0.0100–0.0187%; thyroids, 0.0069–0.0080%. 1 *Melanerpes formicivorus* (Acorn Woodpecker): body, 81 g.; adrenals, 0.0083%; thyroids, 0.0027%. 2 *Sphyrapicus varius* (Yellow-bellied Sapsucker): body, 40.7–43.4 g.; adrenals, 0.0096–0.0111%; thyroids, 0.0060–0.0070%. 2 *Venilornis fumigatus* (Smoky-brown Woodpecker): body, 29.6–31.6 g.; adrenals, 0.0186%; thyroids, 0.0122–0.0148%. 2 *Phloeocoastes guatemalensis* (Pale-billed Woodpecker): body, 227.6–271 g.; adrenals, 0.0064–0.0067%; thyroids, 0.0067–0.0118%.

#### DENDROCOLAPTIDAE

2 *Dendrocincla fuliginosa* (Plain-brown Woodhewer): body, 36.95–42.97 g.; adrenals, 0.0088–0.0133%; thyroids, 0.0083%. 1 *Dendrocincla homochroa* (Ruddy Woodhewer): body, 42.25 g.; adrenals, 0.0084%; thyroids, 0.0090%. 1 *Dendrocolaptes certhia* (Barred Woodhewer): body, 67.10 g.; adrenals, 0.0107%; thyroids, 0.0021%. 2 *Xiphorhynchus guttatus* (Buff-throated Woodhewer): body, 45.9–48.6 g.; adrenals, 0.0081–0.0122%; thyroids, 0.0045–0.0196%.

#### FURNARIIDAE

2 *Thripadectes rufobrunneus* (Streak-breasted Treehunter): body, 51.5–64.8 g.; adrenals, 0.0058–0.0151%; thyroids, 0.0080%. 2 *Xenops minutus* (Plain Xenops): body, 12.0–12.83 g.; adrenals, 0.0116–0.0172%; thyroids, 0.0080%.

#### FORMICARIIDAE

2 *Taraba major* (Great Antshrike): body, 65.8–66.2 g.; adrenals, 0.0092–0.0125%; thyroids, 0.0058–0.0069%. 1 *Thamnophilus punctatus* (Slaty Antshrike): body, 15.42 g.; adrenals, 0.0122%; thyroids, 0.0164%. 2 *Cercomacra nigricans* (Jet Antbird): body, 15.51–19.47 g.; adrenals, 0.0060–0.0111%; thyroids, 0.0081–0.0122%. 1 *Myrmeciza longipes* (White-bellied Antbird): body, 26.59 g.; adrenals, 0.0147%; thyroids, 0.0099%. 1 *Myrmeciza exsul* (Chestnut-backed Antbird): body, 28.80 g.; adrenals, 0.0104%; thyroids, 0.0088%.

#### COTINGIDAE

1 *Pachyramphus polychopterus* (White-winged Becard): body, 19.65 g.; adrenals, 0.0151%; thyroids, 0.0102%.

## TYRANNIDAE

1 *Myiodynastes hemichrysus* (Golden-bellied Flycatcher): body, 43.4 g.; adrenals, 0.0092%; thyroids, 0.0097%. 2 *Myiozetetes cayanensis* (Rusty-margined Flycatcher): body, 22.64–23.73 g.; adrenals, 0.0177–0.0222%; thyroids, 0.0116%. 1 *Myiozetetes granadensis* (Gray-capped Flycatcher): body, 26.6 g.; adrenals, 0.0185%; thyroids, 0.0094%. 1 *Myiarchus ferox* (Short-crested Flycatcher): body, 31.51 g.; adrenals, 0.0071%; thyroids, 0.0052%. 1 *Contopus lugubris* (Dark Pewee): body, 20.23 g.; adrenals, 0.0116%; thyroids, 0.0138%. 1 *Myiobius atricaudus* (Black-tailed Flycatcher): body, 10.62 g.; adrenals, 0.0141%; thyroids, 0.0132%. 1 *Platyrinchus coronatus* (Golden-crowned Spadebill): body, 19.83 g.; adrenals, 0.0144%; thyroids, 0.0090%. 2 *Platyrinchus mystaceus* (White-throated Spadebill): body, 9.62–10.8 g.; adrenals, 0.0052–0.0154%; thyroids, 0.0096–0.0103%. 2 *Rhynchocyclus brevirostris* (Eye-ringed Flatbill): body, 20.54–23.33 g.; adrenals, 0.0129%; thyroids, 0.0085–0.0092%. 2 *Todirostrum cinereum* (Tody Flycatcher): body, 6.14–7.03 g.; adrenals, 0.0122%; thyroids, 0.0107–0.0220%. 1 *Elaenia frantzii*: body, 19.78 g.; adrenals, 0.0147%; thyroids, 0.0165%. 2 *Camptostoma pusillum* (Beardless Tyrannulet): body, 7.31–8.12 g.; adrenals, 0.0049–0.0096%; thyroids, 0.0084–0.0145%. 2 *Leptopogon superciliaris* (Slaty-capped Flycatcher): body, 11.08–13.77 g.; adrenals, 0.0061–0.0182%; thyroids, 0.0051–0.0070%. 1 *Mionectes olivaceus* (Olive-striped Flycatcher): body, 14.46 g.; adrenals, 0.0142%; thyroids, 0.0123%.

## HIRUNDINIDAE

1 *Iridoprocne albilinea* (Mangrove Swallow): body, 12.87 g.; adrenals, 0.0178%; thyroids, 0.0200%.

## CORVIDAE

1 *Cyanocorax affinis* (Black-chested Jay): body, 221.2 g.; adrenals, 0.0095%; thyroids, 0.0113%.

## TROGLODYTIDAE

1 *Troglodytes ochraceus* (Ochraceous Wren): body, 18.3 g.; adrenals, 0.0243%; thyroids, 0.0067%. 1 *Henicorhina leucosticta* (White-breasted Wood-Wren): body, 18.3 g.; adrenals, 0.0243%; thyroids, 0.0067%.

## TURDIDAE

2 *Turdus plebejus* (Mountain Robin): body, 70.6–76.7 g.; adrenals, 0.0083–0.0163%; thyroids, 0.0123–0.0149%.

## SYLVIIDAE

1 *Poliophtila plumbea* (Tropical Gnatcatcher): body, 5.90 g.; adrenals, 0.0188%; thyroids, 0.0085%.

## VIREONIDAE

2 *Vireo flavifrons* (Yellow-throated Vireo): body, 15.61–17.70 g.; adrenals, 0.0183–0.0201%; thyroids, 0.0116–0.0149%. 1 *Vireo leucophrys* (Brown-capped Vireo): body, 13.17 g.; adrenals, 0.0099%; thyroids, 0.0128%. 2 *Hylophilus aurantiifrons* (Golden-fronted Greenlet): body, 9.27–10.19 g.; adrenals, 0.0189–0.0223%; thyroids, 0.0175%.



## PARULIDAE

1 *Vermivora chrysoptera* (Golden-winged Warbler): body, 8.38 g.; adrenals, 0.0117%; thyroids, 0.0215%. 1 *Dendroica aestiva* (Yellow Warbler): body, 9.42 g.; adrenals, 0.0124%; thyroids, 0.0116%. 1 *Dendroica fusca* (Blackburnian Warbler): body, 9.29 g.; adrenals, 0.0165%; thyroids, 0.0133%. 1 *Seiurus motacilla* (Louisiana Waterthrush): body, 18.1 g.; adrenals, 0.0177%; thyroids, 0.0128%. 2 *Oporornis formosus* (Kentucky Warbler): body, 14.0–14.61 g.; adrenals, 0.0105–0.0143%; thyroids, 0.0084%. 2 *Oporornis philadelphia* (Mourning Warbler): body, 11.52–11.84 g.; adrenals, 0.0050–0.0190%; thyroids, 0.0090–0.0146%. 1 *Setophaga ruticilla* (American Redstart): body, 7.45 g.; adrenals, 0.0141%; thyroids, 0.0058%. 2 *Basileuterus melanogenys* (Black-cheeked Warbler): body, 11.86–13.43 g.; adrenals, 0.0143–0.0145%; thyroids, 0.0067–0.0079%. 2 *Basileuterus fulvicauda* (Buff-rumped Warbler): body, 14.32–15.50 g.; adrenals, 0.0147–0.0153%; thyroids, 0.0108–0.0110%.

## ICTERIDAE

1 *Icterus spurius* (Orchard Oriole): body, 21.39 g.; adrenals, 0.0092%; thyroids, 0.0108%. 2 *Icterus mesomelas* (Yellow-tailed Oriole): body, 47.21–57.14 g.; adrenals, 0.0133–0.0138%; thyroids, 0.0055–0.0180%. 1 *Sturnella magna* (Meadowlark): body, 102.3 g.; adrenals, 0.0107%; thyroids, 0.0203%.

## THRAUPIDAE

1 *Tanagra elegantissima* (Blue-hooded Euphonia): body, 14.18 g.; adrenals, 0.0162%; thyroids, 0.0092%. 1 *Tanagra lanirostris* (Thick-billed Euphonia): body, 15.60 g.; adrenals, 0.0227%; thyroids, 0.0092%. 1 *Tanagra imitans* (Spot-crowned Euphonia): body, 13.37 g.; adrenals, 0.0201%; thyroids, 0.0073%. 1 *Tangara guttata*: body, 19.0 g.; adrenals, 0.0352%; thyroids, 0.0095%. *Thraupis virens* (Blue-gray Tanager): body, 30.08–34.16 g.; adrenals, 0.0101–0.0157%; thyroids, 0.0116–0.0121%. 1 *Thraupis palmarum* (Palm Tanager): body, 35.8 g.; adrenals, 0.0163%; thyroids, 0.0095%. 2 *Ramphocelus passerinii* (Scarlet-rumped Tanager): body, 31.3–31.4 g.; adrenals, 0.0132–0.0186%; thyroids, 0.0079–0.0127%. 1 *Ramphocelus icteronotus* (Yellow-rumped Tanager): body, 34.23 g.; adrenals, 0.0059%; thyroids, 0.0074%. 2 *Piranga bidentata* (Flame-colored Tanager): body, 34.2–36.1 g.; adrenals, 0.0140–0.0146%; thyroids, 0.0045%. 1 *Habia rubica* (Red-crowned Ant-Tanager): body, 31.49 g.; adrenals, 0.0069%; thyroids, 0.0118%. 2 *Tachyphonus luctuosus* (White-shouldered Tanager): body, 14.13–15.76 g.; adrenals, 0.0098%; thyroids, 0.0190–0.0258%.

## FRINGILLIDAE

1 *Saltator atriceps* (Black-headed Saltator): body, 96.74 g.; adrenals, 0.0108%; thyroids, 0.0105%. 1 *Cyanocompsa cyanoides* (Blue-black Grosbeak): body, 33.8 g.; adrenals, 0.0090%; thyroids, 0.0094%. 1 *Passerina cyanea* (Indigo Bunting): body, 13.61 g.; adrenals, 0.0163%; thyroids, 0.0086%. 1 *Sporophila minuta* (Ruddy-breasted Seedeater): body, 10.05 g.; adrenals, 0.0087%; thyroids, 0.0105%. 1 *Spinus xanthogaster* (Yellow-bellied Siskin): body, 13.12 g.; adrenals, 0.0111%; thyroids, 0.0050%. 1 *Atlapetes brunnei-nucha* (Chestnut-capped Brush-Finch): body, 45.8 g.; adrenals, 0.0111%; thyroids, 0.0070%. 2 *Atlapetes assimilis* (Gray-striped Brush-Finch): body, 38.9–43.8 g.; adrenals, 0.0132–0.0143%; thyroids, 0.0096–0.0105%.

Among all species studied few show great distinction in size of the adrenals. None are relatively as large as those of the Brown Pelican, those of the Barred Forest Falcon being the largest in this series.

Neither the size of the adrenals nor thyroids appears to bear any relation to the activity of the bird.

The variation in adrenal size in birds appears to be much greater than in mammals.

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## GENERAL NOTES

**A Tern New to the United States.**—On 13 July 1960 banders working in the well-known ternery at Bush Key, Dry Tortugas, Florida, collected an "unusual looking" noddy that proved to be *Anous tenuirostris*. Apparently it is the first example of the small, dark noddies of pantropical seas to be obtained within the A.O.U. Check-list area. The specimen was a male with skull fully ossified and testes measuring  $2 \times 1$  and  $1 \times 1$  millimeters. It had no fat, and its stomach was empty. Scattered, new feathers were evident on the head and body and in the wing and tail coverts. The remiges and rectrices showed little wear but were not freshly molted. Measurements were: total length in the flesh, 348; wing arc, 215; tail, 112; exposed culmen, 40. The iris was brown, the bill and feet black. The skin has been deposited in the collection of the Division of Birds, United States National Museum (catalog No. 472493).

The bird was originally located by Charles A. Sutherland, who, with Warren Y. Brockelman, was recording calls of Sooty Terns (*Sterna fuscata*) and Brown Noddies (*Anous stolidus*) for the Laboratory of Ornithology, Cornell University. It was roosting with 20 or more Brown Noddies on a small, dead tree near the south shore of Bush Key. At close range its sooty-black rather than brownish body, whiter crown, more slender bill, and much smaller bulk were easily seen. The writers made a tentative identification, and ultimately the bird was captured in a mist net. Its collection spurred a closer examination of noddies without result until the evening of 17 July when Mr. Brockelman found another Black Noddy perched on the same snag. This individual was observed at length by him, Mr. Sutherland, Betty Robertson, and two of the writers. It appeared identical to the one collected and could be followed on the wing among the swarms of Brown Noddies by its lighter, more erratic flight.

The smaller, dark noddies have been regarded as two species, *A. minutus* and *A. tenuirostris* (Peters, 1934). Morphological differences between them are slight, and the ranges apparently do not overlap, *tenuirostris* replacing *minutus* in the Indian Ocean. We follow Moynihan's (1959) conclusion that only one species need be recognized, *tenuirostris* having priority.

The species occurs nearly world wide in warmer seas, but is absent from most of the Atlantic Ocean north of the equator and most of the Caribbean Sea. The subspecies *atlanticus* breeds on islands in the tropical and subtropical South Atlantic (Murphy, 1936) and perhaps also on islands in the Gulf of Guinea (Bannerman, 1931). In the Caribbean the species is represented by the subspecies *americanus*, which was long known only from Southwest-of-all Cay (now called Southwest Cay), an island on Glover's Reef off the central coast of British Honduras. Salvin (1864) found a breeding colony of the Black Noddy there 12 May 1862. Several other ornithologists have visited the locality, but all published references to occurrence of the species in British Honduras appear to be based upon Salvin's account or specimens that he collected (Stephen M. Russell, *in litt.* 1 November 1960). Its present status on the British Honduran cays is uncertain. Bond (1954: 6) was told that colonies of noddies on Southwest Cay "had greatly diminished in size." Russell (*in litt.*) suspects that Black Noddies may no longer nest there because he found none 26 April 1956 and E. R. Blake and C. T. Agostini found none 29 May–1 June 1935.

In more recent years the Black Noddy has been reported from several islands of the southern Caribbean. All of these records are presented under "*Anous minutus*

*americanus*," although one (El Soldado Rock, Trinidad) rests upon the identification of a single egg (Belcher and Smooker, 1935: 296), apparently the egg of a Brown Noddy (Bond and Ripley, 1960), and another (Lac, Bonaire) solely upon a color photograph (Vouos, 1957: 152). Definite evidence of occurrence is available for the Venezuelan islands, where specimens have been taken on several islets of the archipelagos of Los Roques (Phelps and Phelps, 1959) and Las Aves (Gines and Yopez T., 1960). The belief that the Black Noddy breeds on Los Roques has now been confirmed (Bond and Ripley, *loc. cit.*). Murphy (1936: 1160) listed "Mauve Noire" as a vernacular name applied to the Black Noddy "in the French West Indies." There is no verified West Indian record (Bond, 1956: 62), however, the name perhaps pertaining to *A. stolidus*.

It was thought likely that the Black Noddies at Dry Tortugas would belong to the subspecies *americanus*, but, surprisingly, the specimen proved referable to *atlanticus* (H. G. Deignan, *in litt.* 28 September and 6 October 1960). Vagrants of this race have reached the West African coast (Bannerman, *loc. cit.*), but it is apparently not otherwise known north of its northernmost breeding stations at St. Paul Rocks and Fernando Noronha. Moreover, the equatorial populations tend to be sedentary (Murphy, 1936). The presence of at least two individuals at Dry Tortugas thus seems most remarkable. It is barely possible, however, that the species has been overlooked in the West Indies and that careful inspection of colonies of *A. stolidus* would be rewarding.

Eisenmann (1955) recommended "White-capped Noddy" as the English name for *Anous minutus*. The name Black Noddy has been as widely used (Murphy, *loc. cit.*; Hellmayr and Conover, 1948; Moynihan, *loc. cit.*) and seems preferable in a descriptive sense. With the present record the A.O.U. *Check-list's* (1957) vernacular name for *A. stolidus*, "Noddy Tern," should become Brown Noddy.

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—WILLIAM B. ROBERTSON, JR., *Region One, National Park Service, Homestead, Florida*; DENNIS R. PAULSON, *Department of Zoology, University of Miami, Coral Gables, Florida*; and, C. RUSSELL MASON, *Florida Audubon Society, Maitland, Florida*.

**Records of Two Migrant Waterfowl for Puerto Rico.**—On 21 December 1960 a Fulvous Tree Duck, *Dendrocygna bicolor helva*, sex undistinguishable, was shot out of a flock estimated at 20 birds by a local hunter, Mr. J. R. Ortega. The ducks were flying over Fuertes Swamp, Loiza Aldea, in northeastern Puerto Rico. Measurements were as follows: length of bill from nostril—32.0 mm. and length of closed wing (chord)—224.0 mm. The skin is now part of the avian collection at this institution, catalog number 1543. According to Bond (*Check-list of the Birds of the West Indies*, 1956, p. 19) only two specimens of this tree duck have been reported previously from the West Indies, one from Cuba and one from Bermuda.

On 17 December 1960 an adult, female, Hooded Merganser, *Lophodytes cuculatus*, was collected at Boquerón in southwestern Puerto Rico. Measurements secured on this waterfowl are: length of bill from nostril—29.1 mm., length of closed wing (chord)—175.6 mm., and length of crest—53.9 mm. This skin is now in the avian collection of this institution, catalog number 1544. There are records from three West Indian islands between November and December. Bond (p. 25 and *First Suppl.*, 1956, p. 2) mentions records from Cuba, where it is considered to be a rare winter resident, an accidental record from St. Croix, Virgin Islands, and a record of one female taken at Martinique, French West Indies.

The writers are of the opinion that the overly severe winter of 1960 in North America was an important factor that may have caused the extreme southern movement in the Antilles of the above species of ducks.—VIRGILIO BIAGGI, JR. and FRANCIS J. ROLLE, *Biology Department, University of Puerto Rico, Mayagüez, Puerto Rico*.

**Yellow-nosed Albatross off the Coast of Long Island, New York.**—Albatrosses are accidental in the North Atlantic Ocean. Only the Yellow-nosed Albatross (*Diomedea chlororhynchos*) and the Black-browed Albatross (*D. melanophris*) are known to have occurred in these waters. Off the North American coast only the Yellow-nosed Albatross has been recorded, and then but three times: September 1884 and 1 August 1913 (Murphy, *Oceanic Birds of South America*, 1: 523, 1936), and 23 July 1934 (Norton, *Auk*, 51: 507-508, 1934) and (Palmer, *Maine Birds*, pp. 28-29, 1949). These occurrences were based on specimens. The present record is the fourth off continental North America and the first for New York state. Within the past two years there have been several unconfirmed sight reports of this species off the east coast of the United States.

On the afternoon of 29 May 1960 an adult Yellow-nosed Albatross was observed and photographed approximately three kilometers (two miles) off Jones Beach, Long Island, New York. The bird was discovered resting on the water in the



**Figure 1. Yellow-nosed Albatross off Long Island, New York, 29 May 1960. Photo by J. Daniel Buckley (Zeiss Contaflex, 45 mm. lens, mounted on 7 x 35 binoculars, high speed ectachrome). Enlargement, courtesy of Josh Wallman.**

company of Great Black-backed Gulls (*Larus marinus*) and Herring Gulls (*Larus argentatus*), and was watched for about an hour by nearly 50 people aboard two boats on a pelagic trip of the Linnaean Society of New York. When first seen at a distance, the albatross bore a striking resemblance to the Black-backed Gulls, but was considerably larger. When approached within 30 meters the albatross and gulls flew up. On the wing the latter were dwarfed in size. Direct comparisons were made both in flight and at rest as close as 12 meters.

The following pertinent characters were noted: bill appeared long, deep, and black, including entire mandible, except that the culmicorn was bright orange-yellow, giving the effect of a stripe on the ridge of the bill; back, wings, and terminal half of tail deep slaty, as were anterior and posterior edges of wings below; center of wing linings, entire underparts, basal half of tail and rump pure white; head and neck white, suffused with light pearl-gray on occiput, nape, and cheeks; dark supra-orbital area, giving a partially masked appearance. An examination of skins at the American Museum of Natural History by the writer, together with still and motion pictures in color taken by several people, confirmed the identification. Dr. Robert C. Murphy has viewed the photographs and concurs. The accompanying black-and-white reproduction of the color photographs indicates that the bird could only be an adult *D. chlororhynchos*.—JOHN L. BULL, *American Museum of Natural History, New York 24, New York*.

**Two Noteworthy Records for California.**—On 31 December 1960 Mr. Charles Kent shot a bright-red adult male Hepatic Tanager, *Piranga flava hepatica*, at Poway, San Diego County, California. The Tanager was first observed on the

ground under a large pepper tree in his yard on 13 December and was not seen again until it appeared in an apricot near his residence in the late afternoon of the day it was collected. The bird was given to Dr. James Crouch of the San Diego State College by Mr. Brode, and Dr. Crouch then gave the specimen, in frozen condition, to the San Diego Society of Natural History. It was identified and prepared as a cabinet specimen by Laurence M. Huey and is now No. 30257 in the Museum's collection. This specimen represents the westernmost occurrence of this species, and is the first record for California.

On 15 October 1960, an adult male Black-throated Green Warbler, *Dendroica virens virens*, was found dead in the garden at No. 1016 Cypress Way, a few blocks north of Balboa Park. A young naturalist, M. J. Briggs, attempted to skin the bird, and it was left in a mutilated condition. The writer later found and identified the bird and, by repairing the damage, made it into a presentable cabinet specimen, which is now No. 30259 in the Museum's collection. This represents the third record for the species in California. The two former records were both from the Farallon Islands; one collected on 29 May and the other seen on 1 June 1911 (Dawson, *Condor*, 13: 168, 1911).—LAURENCE M. HUEY, *San Diego Society of Natural History, Balboa Park, San Diego, California*.

**Recent Additions to the Avifauna of Alberta.**—A check-list of all the birds known to occur in Alberta at the time of publication was included in Salt, W. Ray, and A. L. Wilk (*The Birds of Alberta*, Department of Economic Affairs, Government of Alberta, pp. 511, 1958). Since that time several species not previously recorded have been found within the borders of the province. Two of these have been recorded by Boag (*Can. Field-Nat.*, 72: 173-174, 1958) and Wishart (*Auk* 76: 358, 1959). The following account of the observation or collection of specimens of five species not previously recorded in Alberta brings this check-list up to date.

*Nycticorax nycticorax hoactli*, Black-crowned Night Heron

This species has recently become established as a breeding bird in Alberta. First reports of its occurrence came from G. Freeman of Strathmore, who observed several Black-crowned Night Herons in the vicinity of Strathmore on several occasions during the summer of 1958. Since that time the species has been observed and specimens have been secured at several points as far north as Edmonton. No adult specimen has been taken. The species now appears regularly during the summer in the Strathmore and Tofield areas. Nests have been found at Beaverhills Lake near Tofield. The herons here choose nesting sites in rushes over water in preference to bushes that border the marsh. Mortality by drowning among the young is high.

*Branta bernicla hrota*, Brant

*Branta nigricans*, Black Brant

Three records of Brant in Alberta are substantiated by specimens or by photographs.

A Brant was shot from a small flock of about a dozen birds at Clairmont Lake near Grande Prairie by Mr. A. R. Peterson on 7 October 1957. The head and neck and a description of the bird were sent to the office of the Canadian Wildlife Service in Edmonton. The specimen was apparently not preserved. Mr. Tom



Barry of the Canadian Wildlife Service identified the specimen as a Brant and concluded from the description that the bird was probably a Black Brant.

On 18 October 1959 Mr. Fred Martel of Jasper photographed a Brant as it fed on a grassy slope leading from Lake Annette near Jasper. Mr. Martel was uncertain of the identification of this bird and made field notes of its markings. From the field notes and the photographs it appears that this bird was an intergrade between *Branta bernicla hrota* and *Branta nigricans*. Intergrades of these two species are discussed by Manning, Höhn, and Macpherson (*The Birds of Bank's Island*, Bull. 143, Nat. Mus. of Canada, Ottawa, 1956), who present in Plate VII a photograph of a group of skins of "eight brant, *B. b. hrota* and *B. b. bernicla* graded according to the color of the lower breast." The Brant photographed by Mr. Martel is comparable to the specimen marked Grade IV on this plate, with respect to the color of the breast. It has a broad, white neck ring. It appears to be an intergrade with a slight preponderance of color characteristics of the Black Brant.

On 24 September 1960 Lt. Col. D. G. Greene of Edmonton shot a Brant at Cooking Lake, 42 kilometers (25 miles) east of Edmonton. The bird was alone and in flight. The specimen was presented to the University of Alberta, where it is preserved in the collection of the Department of Zoology. This bird is an immature female American brant, *Branta bernicla hrota*.

These three records are particularly interesting, since they indicate that Brant passing through Alberta may be either the eastern or the western form or intergrades between these two.

*Mareca penelope*, European Widgeon

A male European Widgeon was collected 27 April 1959 by Mr. Bernard Hamm of Grande Prairie. The bird was sitting on the ice of Valhalla Lake about 56 kilometers (35 miles) northwest of Grande Prairie, in company with four American Widgeon. The specimen is preserved in the collection of Mr. Hamm. Although previous sight records have suggested the sporadic occurrence of this species in Alberta, this is the first specimen to be taken in the province.

*Larus glaucescens*, Glaucous-winged Gull

On 2 June 1960 a wounded gull bearing a band was found on the shores of Therien Lake, near St. Paul, Alberta. The band was not removed, and the bird was released. Fish and Wildlife Officer G. W. Steedsman sent the information through the usual channels reporting the bird as an immature Ring-billed Gull.

The band (#597-56837) had been placed on a young Glaucous-winged Gull by Wm. Merilees of Vancouver, B. C. The bird was banded on Christie Island, 32 kilometers (19 miles) NNW of Vancouver, on 19 July 1959. When queried upon the possibility of error in identification, Mr. Merilees replied (priv. corresp.), "The bird was probably five to six weeks old. . . . There can be no mistake as to species because no other gulls are known to nest in the area." The Glaucous-winged Gull has never previously been reported so far inland in Canada. The A.O.U. Check-list (1957) reports only one other comparable inland occurrence in North America.—W. RAY SALT, Department of Anatomy, University of Alberta, Edmonton, Alberta, Canada.

**Comparison of Female Mallard with Female New Mexican Duck.**—In 1958 the New Mexico Department of Game and Fish began a project to attempt the

restoration of the New Mexican Duck (*Anas diazi novimexicana*) by artificial propagation and stocking. In the process of establishing a captive flock for propagation purposes, there arose the problem of distinguishing purebred individuals from Mallards (*Anas platyrhynchos*). The purpose of this note is not to debate the subspecific status of the New Mexican Duck. It may be possible, however, in the future to contribute to this subject data collected from pen-raised individuals of known parentage.

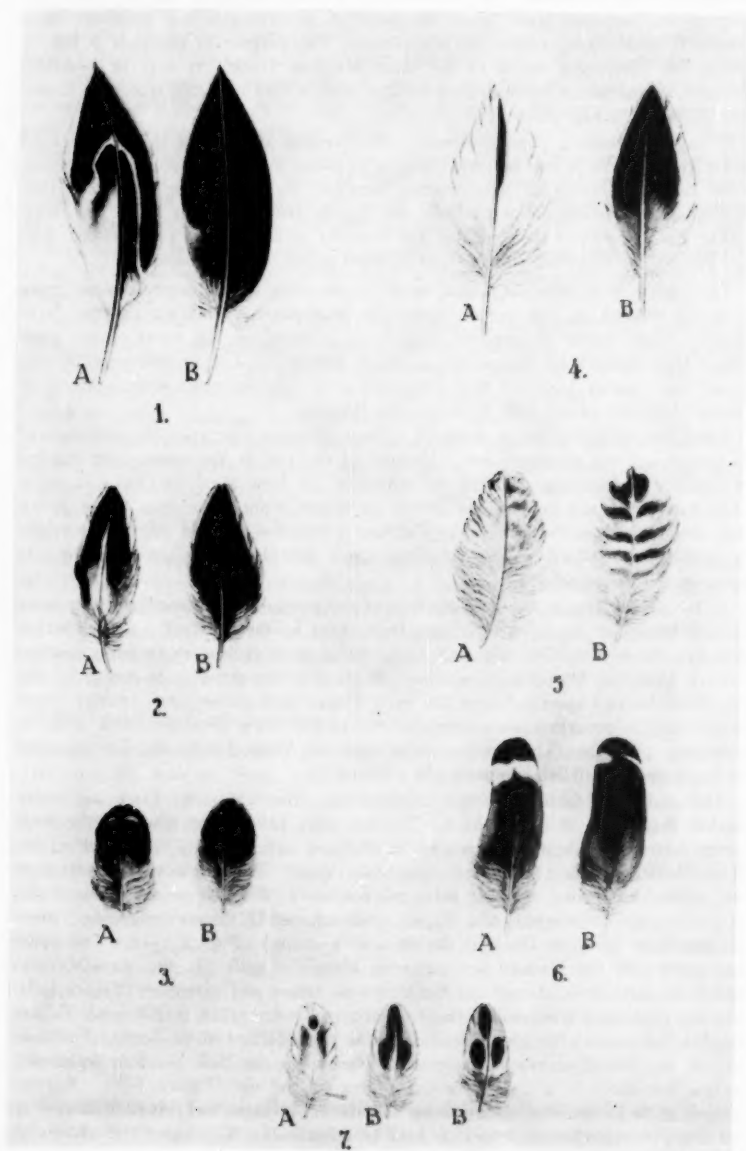
In mature breeding plumage there is no question of identity in the males of either group, as there can be little question of males in breeding plumage resulting from varying degrees of hybridization between the two. The characters that distinguish the female Mallard from the female New Mexican Duck are more subtle, and a search of the literature has revealed no satisfactory comparison. For this reason the following comparisons of adult plumage are presented.

The female New Mexican Ducks used in preparing these descriptions are from a brood trapped at San Simon marsh in southwestern Hidalgo County, New Mexico. The purity of breed of these birds is based on the males of the same brood that showed no indication of mixed ancestry. The development of this brood was closely observed and compared at weekly intervals with a brood of young Mallards, raised with them for this purpose.

From the beginning there appeared to be a difference between the two species, in weight and bill measurements. Because of the size of the sample and the improbability of obtaining a substantial sample of the New Mexican Ducks, it seems improbable that any conclusions should be drawn from these data. One factor that would confuse the issue in any further evaluation of wild individuals is the probability of Mallard x New Mexican Duck hybrids that might close the gap between the two species.

In the downy stages the dark portions of the down patterns are lighter or more reddish-brown in the New Mexican Duck than in the Mallard. As feathering develops the young New Mexican Duck takes on a darker, more finely marked pattern than the Mallard. The breast feathering in particular is markedly different in the two species during the early stages of development. Another brood very nearly approached our criteria of the perfect New Mexican Duck while in immature plumage. However, definite signs of Mallard hybridization appeared in the males when adult plumage was attained.

The main tail feathers of the adult female New Mexican Duck are much darker than those of the Mallard. There is very little or no white on the three outer rectrices. These feathers on the Mallard have a white edge, and on the New Mexican Duck a narrower, light-brown edge. There is also a difference in the central patterning of these main tail feathers. Whereas on the Mallard this is very light, almost white, and shaped as an inverted U, the corresponding pattern on the New Mexican Duck is darker and V-shaped (Figure 1-1). The upper tail coverts of the Mallard are patterned along the quill. In the New Mexican Duck this pattern is absent, and the border is darker and narrower (Figure 1-2). On the specimens from which these descriptions were taken, a difference existed on the lower back or rump feathers. On the Mallard these feathers, a dark brown, are barred across the upper end, whereas on the New Mexican no barring exists, but there is a lighter brown edging at the tip (Figure 1-3). Further examination indicates a variation on this factor in some individual Mallards, so its use as a criterion of separation may be questioned. The under tail coverts on



the Mallard are white or near-white with a central stripe of brown; on the New Mexican Duck they are dark brown with an edging of light brown. Observations made so far indicate this is the most striking single difference between the two (Figure 1-4).

The small under wing coverts, at the proximal end of the ulna, are boldly barred on the New Mexican Duck and on the Mallard are hardly marked at all (Figure 1-5).

The flank area of the Mallard is lighter than the flank on the New Mexican Duck, with more bold patterning as described for the tail feathers. The buff area under the chin and throat is darker on the New Mexican Duck. This area on the male was described by Huber (*Auk*, 37: 273-274, 1920) as "pinkish buff." The head of the New Mexican Duck is browner with very little of the greenish, iridescent effect present on the Mallard.

The bill of the female New Mexican Duck as immature was more finely spotted and the spots less numerous than on the Mallard. As maturity developed and the orange and black of the bill of the female Mallard intensified, the bill of the female New Mexican Duck became darker, shading to olive-green with very little orange near the base.

In the wing, the tertials of the New Mexican Duck are overlaid with a slightly iridescent, greenish cast, and in the Mallard the same area is gray. The speculum in the New Mexican Duck was described as "dark dull bluish-violet" by Huber. In some cases and under poor light conditions this is correct. However, under other conditions, especially when the wing is wet, the speculum is greenish-blue to really bright green. The white border of the speculum on the forward edge is much less distinct on the New Mexican Duck than on the Mallard (Figure 1-6) and in some cases almost absent; the white being diffused with brown and dusky splashing.

The breast of the Mallard is much lighter in color than that of the New Mexican Duck. The breast feathers of the Mallard are light tan to tannish-gray, with a brown spot near the center of the tip, and lighter brown stripes on either side of the quill. On the New Mexican Duck this may vary from three larger brown spots, one at the tip and one on either side of the quill, to a pattern in which these spots are joined in a *fleur-de-lis*-like pattern with a light stripe along both sides of the quill (Figure 1-7).—WILLIAM S. HUEY, P.O. Box 4201, Santa Fe, New Mexico.

**An Enigmatic Northward Migratory Flight off North Carolina in September.**—On 26 September 1960 I witnessed northward flights of migrating landbirds across Onslow Bay, North Carolina. I observed the migrants with binoculars from the bridge of a U.S. Navy ship that was anchored about three kilometers (two miles) off-shore, just north of the New River Inlet (about 58 kilometers—35 miles—west-southwest of Beaufort). By referring to a gyroscopic compass

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**Figure 1. Feather comparisons between New Mexican Duck (*Anas diazi novimexicana*) and Mallard (*Anas platyrhynchos*) females in adult plumage. These feathers are from various sections as listed, where obvious differences occur. 1—tail, 2—upper tail coverts, 3—saddle, 4—under tail coverts, 5—under wing, 6—secondary wing coverts, 7—breast. In all cases the specimen labeled A is from the Mallard and B from the New Mexican.**

repeater mounted on the bridge, I was able to estimate the approximate direction of flight of birds flying toward or away from the ship. Most of the birds were warblers, although several Yellow-shafted Flickers (*Colaptes auratus*) and a Wood Thrush (*Hylocichla mustelina*) also flew by. The only warblers positively identified were two Redstarts (*Setophaga ruticilla*) and a Black and White Warbler (*Mniotilta varia*); a Yellowthroat (*Geothlypis trichas*) was found dead on the ship.

TABLE 1

FLIGHT DIRECTIONS OF LANDBIRDS OFF NORTH CAROLINA, 26 SEPTEMBER 1960

Time	Identification	From	To	Remarks
0540	flicker			landed
0540	3 small passerines			landed
0545	flicker	south		
0553	small passerine	270°		
0554	small passerine	185°		landed
0555	small passerine	300°		called "zip"
0600	warbler	305°		
0602	Black and White Warbler			on ship
0607	small passerine		045°	
0648	Wood Thrush		050°	landed before flying
0648	Redstart	250°		
0649	2 warblers		050°	
0650	Redstart (male)	250°		
0650	warbler (yellowish)	250°		
0651	flicker		080°	
0659	warbler			circled
0711	flicker			landed
0724	small passerine (brown)			landed
0725	flicker	225°		landed
0729	flicker		045°	
0734	(warbler)			"zeet" heard overhead
0735	(warbler)			"zeet" heard overhead
0737	small passerine (olive)		060°	landed
0737	warbler			landed

Table 1 presents a summary of the birds seen between 0530 E.S.T., when it first began to become light, and 0740, when I left the bridge. The directions are in degrees true, as estimated. It is evident from Table 1 that the general direction of flight was from the south to the north. More properly, the directions appeared to parallel the coastline, which runs approximately 240° to 060°.

The weather was cool and foggy, although the coast could be seen from the ship. Most of the birds were seen arriving or departing from the ship. But some were seen only while on the ship, and their directions of flight are unknown. Such was the Black and White Warbler that I discovered at 0602 on a life raft. A sailor explained that, a moment before I arrived, he had frightened about half a dozen small birds from inside the raft. Apparently they had been seeking shelter from the unusual cold and from the wind, which was coming from 025°-035° at about 20 knots. A warbler at 0737 took off facing 060°, but the wind carried it backward; after losing several hundred meters, the bird swooped down near the water, flew back to the ship and landed. I noted that flickers

invariably flew close to the water, perhaps to escape the wind. A warbler at 0659 circled higher and higher above the ship until the bird was out of sight.

A female Yellowthroat was found dead on the ship and given to me. I noted that it had none of the subcutaneous fat reserves characteristic of many warblers that I have banded during fall migrations in past years. After inspecting the abdomen, flanks, and furculum, I dissected the bird and likewise found no visible fat stored in the alimentary tract. The autopsy confirmed its sex, since the specimen appeared to have a partially recrudescant left ovary. The bird seemed to have died of a broken neck, possibly as the result of flying into some part of the ship.

Why should these migrants have been heading north? Lack (*Auk*, 77:171-209, 1960) has recently concluded that in north-temperate regions, fine weather, clear skies, light winds, and, in autumn, cold are favorable for normal, migratory flights. The migration on the morning of the 26th followed a night with clear skies and a north-northwest wind. The synoptic weather map showed a low-pressure area near Bermuda and a high-pressure area over the Eastern United States. Since air movement around a low is counterclockwise, and, conversely, around a high is clockwise, a trough of air should have been moving from the north down the Atlantic coast to the south on that morning. This conclusion is in accord with my observations on the local surface winds. At any rate, all prevailing conditions except the fogged-over sky were not only favorable but were ripe for normal southward migration. Sky cover is known to halt migration. The warbler that circled above the ship may be evidence of confusion in navigation. However, the coastline was visible, and most of the birds were well oriented to the northeast. It seems unlikely that navigational difficulties per se caused the reversal in flight direction.

The emaciated Yellowthroat could indicate that the birds made long flights the previous night and exhausted their lipid reserves. But, in that case, one might expect the birds to settle down on the coast to feed, rather than to reverse the direction of flight.

Recently, Baird and Nisbet (*Auk*, 77: 119-149, 1960) have reviewed northward fall migration along the Atlantic coast, although they had few at-sea records available. They point out that northwestern-flying migrants appear to be re-orienting toward the coast after having "drifted" to sea during the night because of northwest winds. However, the North Carolina flight was to the northeast after a night of northeast winds, and was *parallel* to the mainland coast, not directed toward it. The other explanations for northward fall flights reviewed by these authors (especially p. 134) likewise fail to explain either the occurrence or orientation of the flight. I am indebted to several Navy aerographers who supplied and helped analyze meteorological data, and to other Navy personnel for assistance in observations. Dr. Carl W. Helms helpfully criticized the manuscript. —JACK P. HAILMAN, *Department of Zoology, Duke University, Durham, North Carolina.*

**Interspecific Relationships among Birds.**—Field observers have often observed birds of one species pursuing individuals of another species. Such interspecific encounters usually occur during the reproductive season, and often involve the chasing or harrying of a larger species by a smaller bird. My own observations in Oregon most frequently involved Sparrow Hawks (*Falco sparverius*) or Brewer's Blackbirds (*Euphagus cyanocephalus*) diving at Red-tailed Hawks (*Buteo jamaicensis*), during April, May, and June. Blackbirds were also seen

pursuing a Turkey Vulture (*Cathartes aura*) near Bend on 29 May 1954, and a Swainson's Hawk (*Buteo swainsoni*) at Silver Lake on 10 June 1954. Observations involving Sparrow Hawks have been reported previously (Roest, *Auk*, 74: 1-19, 1957). If a larger bird of prey is observed chasing a smaller bird of any species, the relationship is interpreted, usually correctly, as predation, but that is not the subject of this note.

The small-chases-large relationship appears to hold for larger forms than those mentioned above as well. A Golden Eagle (*Aquila chrysaetos*) was observed being pestered by a pair of California Gulls (*Larus californicus*) over the Owyhee Reservoir on 10 June 1949, and two Swainson's Hawks were seen chasing a Golden Eagle near Summer Lake on 3 June 1954. I saw a Marsh Hawk (*Circus cyaneus*) pursue a Red-tailed Hawk near Corvallis on 3 December 1950, and on 20 March 1954 one was observed giving chase to a Turkey Vulture in the same general area. In both instances the Marsh Hawk was a female. A Red-tailed Hawk was observed chasing a Turkey Vulture on 24 April 1954 near Bend.

These last observations suggest a possible interspecific dominance hierarchy: Marsh Hawk over Red-tailed Hawk, Red-tail over Vulture. A similar indication may be found in two observations made near Albany, on 30 April 1954. A Brewer's Blackbird was seen chasing a Robin (*Turdus migratorius*), and a short time later a Meadowlark (*Sturnella neglecta*) was observed chasing a Brewer's Blackbird. Unfortunately, such spring observations may mean nothing more than territorial defense of the nesting area.

Fall records may be more significant. In contrast to the blackbird-chases-robin contact mentioned above, on 12 October 1954 several Robins were seen harrying individual members of a large flock of Brewer's Blackbirds feeding in a stubble field near Bend.

Recognition of the other species is certainly an important factor in determining the type of interspecific reaction that will result from a contact. A flock of Canada Geese (*Branta canadensis*) at Mirror Pond Park in Bend, feeding quietly on the grass, became noticeably disturbed at the approach of a large flying bird while it was still some distance away, watching it carefully and edging toward the water. As the bird approached it soon became recognizable as a Raven (*Corvus corax*), and the geese turned back to feeding without further concern.

Although recognition may be an important factor, it is not necessarily a very critical one, as the following observations on a Mute Swan (*Cygnus olor*) at Mirror Park Pond indicate. During the breeding season the male swan was quite active in defending the nest site against Canada Geese that nested nearby, but ignored the geese away from the nest and at other times of the year. In January 1954 a wing-clipped Snow Goose (*Chen hyperborea*) was released in the park. The male swan refused to let the goose enter the water, charging in from as much as 30 meters away to drive the goose ashore. Long-time residents subsequently told me that this (?) swan had behaved very much the same way several years before, when a White Pelican (*Pelecanus erythrorhynchos*) spent a few days in the park during late summer or early fall. The pelican was not tolerated in the water while the swan was anywhere in sight. It seems that any large white bird was sufficient to provoke aggressive behavior by the male swan.

Little work has been done on this subject of interspecific behavior among birds. Further observations, and possibly experiments, especially during the late summer, fall, and winter months, might provide some very interesting conclusions regarding



interspecific dominance relationships, such as those discovered among small mammals by Calhoun (1959, N. Am. Cen. Sm. Mamm., Release No. 10, Adm. Pub., U.S. Dept. Health, Education, and Welfare, Public Health Service). These in turn may enable us to understand the structure of avian communities much better than we now do.—ARYAN I. ROEST, *Biological Sciences Department, California State Polytechnic College, San Luis Obispo, California.*

**Nest-Shifting Behavior of the Ashy Wren-Warbler.**—The Ashy Wren-Warbler, *Prinia socialis* Sykes, is a common bird found mainly in the central, western and southern parts of the Indian Union, East Pakistan, and Ceylon. Its nesting season ranges from March to September but more commonly immediately after the onset of the monsoon. It is known to build two types of nests (Salim Ali, 1956; Dharmakumarsinhji, 1955). One is similar to that of a tailor bird (*Orthotomus sutorius sutorius* Pennant) and is constructed by arranging fibers in a circular manner inside a funnel formed by one or two leaves stitched together at the margin. The other is an oval bag of woven fibers stitched together with several supporting leaves. I have noticed a third variety in a hedge (*Clerodendron phlomidis*) where the bag of fibers was attached to the slender twigs only by means of cobweb without incorporating the small leaves of the plant. The species is known to require about two weeks for completion of its nest. The clutch size is three or four, and the period of incubation 12 days.

Early in July immediately after the first rains, I noticed in my garden a pair moving about together and copulating on a tree at a height of about five meters from the ground. On 12 July they started building a nest on a plant (*Nyctanthus arboritris*) at about 65 cm. from the ground, both the male and the female participating in the construction. The nest was of the first type, with only two leaves sewn together because the leaves of this plant are large. On the 17th I built a hide at a distance of about one meter from the nest and took photographs. With the click of the camera the bird was visibly restless and agitated. I again took photographs on the 19th. On the morning of the 20th, when I was in the hide watching the birds, to my astonishment I found them by turns removing the nest material bit by bit. They first started with some of the cobweb material and then with the fibers. Each time the bird flew directly to a spot about 30 meters away, and I found that a new nest was being built there with the material of the old nest, this time on another plant (*Lantana camara*) at about the same height. This nest was of the second type, probably because the leaves of this plant were smaller. During the building of the first nest the bird always came to the nest by a circuitous route through shrubs and hedges, and the rate of building was also rather slow. But in the building of the second nest, flight was direct from the original nest to the second; the frequency of the flights to the nest was naturally several times greater. By the evening of the 22nd practically all of the nesting material had been shifted. On the 23rd I watched both the birds bringing material at dusk late in the evening. On the morning of the 24th I noticed in the new nest the first egg of the clutch; the second appeared on the 25th, the third on the 26th, and the 4th on the 27th.

On 6 August I built a hide near this nest and took a few photographs. On the next morning to my surprise I found that all the four eggs had disappeared from the nest and that there were no pieces of the shell to be found anywhere around. However, I did see the bird visit the nest until noon but not later. On the 9th I noticed the pair again selecting a nesting place. They even inspected the

remnant of the nest but did not build there. The hide at this nest had been removed after the second nest was completed, and so there was nothing to dissuade the birds from nesting there. They selected a spot on the opposite side, thus making the location of the three nests at the three angles of a triangle, more or less equidistant from each other, with the second nest at the apex of the triangle. The second nest was completely abandoned, and the third nest was built by the side of the compound wall with freshly collected material. This time the plant chosen was *Bougainvillea spectabilis*, and the type of nest was the same as the previous one. The process of nest building was at the usual speed. On 18 August when this was nearing completion, I noticed, and so did these nesting birds, a Crow-pheasant (*Centropus sinensis* Stephens) that came from the direction of the second nest to this nest and put its head into it for eggs or young ones. This suggested the fate of the four eggs in the second nest. The birds thereafter abandoned the nest and did not nest again for the year. Ordinarily their nesting season extends from March to September.

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- J. C. GEORGE, *Division of Avian Biology, Department of Zoology, M.S. University of Baroda, Baroda, India.*

**A New Method of Preserving Bird Specimens.**—In the fall and winter of 1957–1958 I had occasion to preserve more than a hundred birds, mostly passerines, which had been killed at a television tower south of Aiken, Aiken County, South Carolina. In the course of this work I evolved a method whereby both the skin and the major part of the skeleton of a given specimen could be saved. This method is as follows.

The mouth and deep gashes are plugged with cotton. The wings and legs are then examined; the side on which the appendage bones are unbroken is the one where the opening incision is made. This incision extends from the eyelid back along the side of the neck to the shoulder region. It is continued as a circular incision, which is made against the body around the base of the wing. From this stage on, an absorbent, cornmeal or perhaps hardwood sawdust, is liberally applied and serves to keep the feathers dry. Skin and feathers are then stripped off the wing. From the circular incision in the shoulder area an incision is carried back to the area where the thigh meets the trunk, and another circular incision is made around this joint. Skin and feathers are stripped off the thigh. The incision is extended back to the region of the base of the tail. The skin is then loosened from the body both dorsally and ventrally, with cuts being made through the tail-base region (the pygostyle and some caudal vertebrae admittedly may be lost in this process) and through the knee joint and humerus of the appendages on the side opposite the opening incision. The skin is reversed over the neck and skull, this being facilitated by the split extending to the eyelid. Just anterior to the lacrimal bones a transverse cut is made. This leaves the bill with the skin. If the bill is to go with the skeleton, the skin is carefully detached from the skull in the region of the bill base. This of course leaves one with a more nearly complete

skeleton but also with a beakless skin. Although lacking somewhat in esthetic appeal, a beakless skin is still valuable, particularly if bill measurements are included among data accompanying the skin.

The body, which includes the tail and leg bones on one side as well as most, or all, of the skull, is then examined. Sex and, where possible, age are determined; the specimen is weighed and visceral organs are preserved. The eviscerated body is bound with thread into a sort of ball and hung up to dry. Completion of preparation of the skeleton can be accomplished through maceration or, better, through use of dermestid beetles. Anderson (*Methods of Collecting and Preserving Vertebrate Animals*, 2nd ed., rev. Ottawa: National Museum of Canada Bull. No. 69, 1949), among others, provides details as to procedure. One may wish to preserve specimens for studies in myology, neurology, angiology, or splanchnology, in which event the body should be placed in a suitable fluid preservative and provided with a label bearing data considered minimal for the bird-skin label. For detailed suggestions concerning alcoholic specimens and skeletons of birds, see Berger (*Auk*, 72: 300-303, 1955; *Auk*, 73: 452, 1956). Specimens thus preserved should be suitable for extensive myological study, even though, as Berger in his earlier note (1955) points out, skinning does remove or destroy dermal muscles.

The base of the tail and the leg and wing bones attached to the skin are then cleaned in the usual fashion. The oil gland is removed. The preparator should avoid "stripping" the secondaries from their attachment to the ulna. Fat is scraped from the skin. If small quantities of a powder called "Pounce" (Keuffel & Esser Co.) are applied to the skin, much of the residual grease is absorbed. Where necessary the plumage is cleaned and dried. A little ball of cotton is used to replace the eyeball, with a flattish wisp of cotton extending down alongside the skin of the neck region. With heavy- or broad-billed species it is desirable to "build up" the head region so that its thickness is about the same as the maximal bill width. The skin, after being dusted with arsenic, is arranged on a flat surface, such as a piece of cardboard (a 5- x 8-inch filing card serves well for small passerines), in a suitable manner. Figure 1 illustrates the type of skin arrangement that I tend to favor. One should bear in mind that none of the body's contour feathers have been plucked and discarded; hence, even though one gets the impression of seeing the contour feathers of one side only, one is actually seeing more. Thus, the feathers forming the periphery of most of the dorsal and ventral regions are actually feathers of the "other side." The bill is closed by passing a threaded needle through the nostrils and then tying the thread around the basal part of the lower mandible. A bit of Duco cement applied to the anterior palatal region often facilitates securing the mandibles in a natural, closed position. The tail feathers are affixed in spread position by means of a heavy-paper strip (cut from a 5 x 8 card) smeared with Duco cement and attached crosswise beneath these feathers approximately where the under tail coverts terminate. The ends of this strip can be cut off flush with the edge of the outer webs of the outermost tail feathers. Another piece of cardboard bearing weights amounting to several grams (the larger the specimen, the greater the weight) is set down on the carefully arranged skin so that it will be more or less flattened. The skin is then allowed to dry. It should probably remain undisturbed for a minimum of several hours at room temperature, but if it can be placed on or in a drying oven, or perhaps on a radiator, it will dry sufficiently in a half hour or less. The weights



*Melospiza georgiana* ♂ ad.

Channel 6 TV Tower, SW Aiken Co., S.C.

October 26, 1957 1978 R.A. Norris Fat/tot. wt.

Wt., 19.2 Wt. subcut. fat, 1.58 Heart wt., 0.21 = 8.2%

Bill (exp. cul.), 10.5 Bill (nostr.), 8.3 Bill dpth, 5.3 Bill width, 4.5

Wing (chord), 60.5 Wing (flat), 62.5 Tail, 56.5

Tarsus, 21.6 Molt? No Wing area and formula (over)

Skel. prepared

are removed from the dried skin, and a plate of glass or transparent plastic is then placed over the specimen. The specimen, sandwiched between this plate and the cardboard underneath, is then inverted so that the underside faces upward. The cardboard is removed. From the head region to the base of the tail Duco cement is applied to the skin and, in small quantities, to such feathers as may be underturned. Whereas it is not necessary to cover the entire undersurface with cement, it is well to have the cement distributed over all the major areas. A little more is applied to one side of the tarsus and toes, so that they will stick to the card. A piece of white cardboard or other mounting material (again, unlined 5 x 8 cards are suitable for small passerines) is obtained. (In my own work I use a card on which sundry data, as shown in Figure 1, already have been entered.) The piece of glass or plastic bearing the specimen is then held up above the preparator's head and the mounting card is brought down against the specimen, the cement causing the skin to adhere to the card. The advantage of the transparent plate is that it enables the worker to place the specimen exactly where he wants it on the mounting card. A little cement is extruded in the region of the under wing coverts, this assuring the wing's adherence to the rest of the skin. The mounted specimen, which may be weighted again, is set aside until the cement hardens; again, if artificial heat is used the hardening or drying takes only a short time.

Data pertaining to the specimen may be recorded, as suggested above, before the specimen is skinned. With smaller passerines it is convenient to enter the data on the same side of the card with the specimen. If the specimen is too large or the data are too extensive, a second card can be attached to the first with drafting-tape hinges and the data can be entered on the second card. In my own work I usually have a second card on which I record a wing-area tracing, wing-formula data, and other information. Whereas it is easy to "clutter" a conventional, 3- by 5 $\frac{1}{4}$ -inch museum label (or even two of them) attached to a conventional study skin, it is not so easy to clutter what we may call "aviarium cards," of which there may be more than one for each specimen.

Folders provide protection for the flat, card-mounted skins. For many passerines these can readily be made from halves of standard-sized manila folders. One half can be folded to make a folder that is approximately 6 x 8 $\frac{1}{4}$  inches. This accommodates a specimen on a 5 x 8 card. It has been my practice to print the generic and specific names, as well as the collector's initials and catalog number, in the upper left-hand corner of the folder. Data so placed are useful in filing and in the replacement of specimens in correct folders. For passerines I have found it convenient to file the specimens alphabetically by genus and species. If flat skins should be arranged in large collections or "aviaria," some other filing scheme might well be used.

The above-described method of preserving bird specimens is not without its disadvantages. Some that come to mind are as follows: (1) Neither the under tail coverts nor the underside of the tail shows in the flat-mounted skin. The tail coverts can, however, be clipped off and mounted separately, close to the specimen, as I have done with Catbirds and other species having distinctively marked

**Figure 1. An example of a flat skin mounted on an "aviarium card." The drawing was made from a specimen of the Swamp Sparrow in the writer's collection.**

under tail coverts. Where it is particularly desirable to see the ventral aspect of the tail, a window of suitable size could be cut in the card. (2) Comparison of skins in series is not as easy with flat mounts as with regular study skins. (3) Where beaks are kept with skeletons or alcoholic specimens, the beakless skins are rather "incomplete looking" and, in a measure, less useful than would be ones with beaks intact. (4) Large birds might present difficulties, although it is believed that use of appropriate materials (a relatively inexpensive mounting medium, heavy cardboard or fiberboard, etc.) and special procedures (such as the use of a thin underpadding of cotton or other material) would obviate these difficulties.

Some advantages of the method are these: (1) There is an economical use of bird specimens, wherein one saves a skeleton or alcoholic specimen as well as a skin and can associate these (which would bear identical catalog numbers) with one another. (2) There is an economical use of space, the flat-skin collection requiring substantially less space than a collection of conventional study skins. (3) The time required for preparation of flat skins is somewhat less than that needed for conventional skins; this is particularly true when one is "set up" to prepare flat skins in numbers. (4) Flat skins are easier to prepare than regular skins, especially as regards the late, skin-assembly phase of the work. (5) There is ample space for data on the card or cards, as mentioned earlier. These data are likely to be more valuable when accompanying the specimen than when recorded in a field notebook, which might not always be deposited in the same place as the specimen. The importance of having data with specimens has been emphasized by Van Tyne (*Auk*, 69: 27-33, 1952). (6) Linear measurements, if not taken in advance (where possible, I prefer to take these in advance), can be taken from flat skins as easily, I believe, as from regular study skins (bill width being a probable exception). Admittedly, quantitative relationships between flat-skin wing measurements, on the one hand, and "chord" and "arc" measurements, on the other hand, remain to be worked out for different species. Color measurements, which may become increasingly important as a refinement in taxonomic procedure, can, in my opinion, be taken more easily from the flattish surfaces of the carded skins. (7) Where specimens are subject to much handling, as by students, the skins mounted on cards show less wear and tear through the years than do unprotected, conventional study skins.

This study is a byproduct of ecological research supported by an AEC grant (Contract At(07-2)-10).—ROBERT A. NORRIS, *University of Georgia Ecological Studies, AEC Savannah River Plant area, Aiken, South Carolina. Present address: 427 Eureka Street, San Francisco 14, California.*

**Dichromatism in Juvenal Yellow Warblers.**—According to Dwight (See Bent, *Life Histories of North American Warblers*. U.S. Natl. Mus. Publ. No. 203. 1953: 170) the juvenal plumage of the Yellow Warbler (*Dendroica petechia*) is uniform among all individuals of the species. He described the plumage as being pale olive-brown above; wings clove-brown, broadly edged with bright olive-yellow paling at the tips of the quills, edge of the outer primary bright lemon-yellow; below pale sulphur-yellow, unstreaked; tail pale clove-brown, inner webs lemon-yellow, outer webs edged with olive-brown. On 27 June 1960 I collected two sibling Yellow Warblers (WES 620 and 621) from a nest near Saronia, Washburn County, Wisconsin. The nestlings were about nine days old and were from



a nest that I had under casual observation since the time of egg laying. Four eggs, of which three hatched, were laid in the nest. One young disappeared prior to the date of collection. I have no data pertaining to the plumage of the missing nestling. The plumages of the birds collected are distinctly different and contrast with Dwight's description. The coloration of WES 620 resembles, in part, the juvenal plumage of the nominate race as described by Ridgway (*The Birds of North and Middle America*. Vol. 2. U.S. Natl. Mus. Publ. No. 50. 1901: 509); whereas WES 621 more closely resembles Dwight's description. Colors in my descriptions are from Chapman (*Handbook of Birds of Eastern North America*, Appleton & Co. 1919: 448). The adults appeared to be of normal plumage coloration. No attempt has been made to sex the nestlings, which are preserved in alcohol.

WES 620—Upperparts olive-brown; wings fuscous lightening at tips to greenish-yellow; underparts, breast brownish-ashy, flanks and belly cream-buff. The visible portion of the short rectrices was pigmented similarly to the remiges. A few mouse-gray down feathers remained along the capital tract.

WES 621—Upperparts rich light olive-green; wings same as in WES 620, but somewhat more developed and two whitish wing bars were noticeable. Underparts, breast, belly, and flanks, light chrome yellow; crissum somewhat brighter. This was the larger of the two birds, perhaps being a day older. The underparts of this specimen bear resemblance to Dwight's description, but the over-all coloration appears to be brighter.

The fact that two conditions of juvenal plumage coloration (one similar to Ridgway's description and the other similar to Dwight's) occurred within one brood of young is of interest.—WILLIAM E. SOUTHERN, *Department of Biological Sciences, Northern Illinois University, DeKalb, Illinois*.

**Old Record of Baikal Teal in North Carolina.**—On 19 February 1961 I examined and photographed an adult male Baikal Teal (*Anas formosa*) that had been killed near Swan Island, Currituck County, North Carolina, by F. W. Curtis on 9 December 1912. I sent color transparencies of the bird to the U.S. National Museum, where the identification was verified by Herbert G. Deignan. The specimen was arranged in an old-style, game-mount, hanging by one foot with the wings partially spread and the head pointing downward. The bird has been enclosed in a glass case in the clubhouse of the Swan Island Club, Inc., since 1912, and had not been identified previously.

The A.O.U. *Check-list of North American Birds* (Fifth Edition, 1957) lists two previous records of *A. formosa* in North America, outside of Alaska. A specimen was taken near Brentwood, Contra Costa County, California, on 13 December 1931 (Moffitt, 1932. *Condor*, 34: 193). A single bird was seen by members of the Columbus Audubon Society on the Scioto River, Delaware County, Ohio, in April 1933 (Trautman, 1935. *Ohio Dept. of Agric. Bull.*, 1: 1-16). Each was believed to be an escaped bird (Swarth, 1932. *Condor*, 34: 259 and Trautman, 1940. *The Birds of Buckeye Lake, Ohio*. Univ. Mich. Press). J. Hatter (1960. *Condor*, 62: 480) collected an immature male at Ladner, British Columbia, on 20 December 1957. Whether the specimen in North Carolina was an escapee is not known; however, I know of no aviary, zoo, or park that was near this section of the Atlantic Coast in the early nineteen-hundreds.—PAUL W. SYKES, JR., 1522 Lafayette Blvd., Norfolk 9, Virginia.



**Recent White-tailed Kite Record in Texas.**—On 24 May 1960, while traveling south on U.S. Route 77 in Victoria County, Texas, about one and one-half kilometers north of the McFaddin turn-off, my wife and I observed a White-tailed Kite (*Elanus leucurus majusculus*) in flight beside the highway. We observed the bird with 7-power binoculars. The white tail, white head, and other salient field marks were clearly seen. We were able to keep the glasses on it for about five minutes. The area was one of low vegetative growth and small scattered trees and bushes.—ROBERT F. MASON, JR., Route 3, Box 663, Orlando, Florida.

**Unusual Behavior of House Wren.**—For several years house wrens have nested on my home grounds. Usually their behavior was as expected from our knowledge of the species; but the following incident was unusual. A pair nested in a box attached to the south wall of the house and near a grove of evergreen trees. The brood had left the nest in the usual way and had been all day in a gully more than 30 meters away. At dusk I heard the female near the nest box chattering and calling to her young. I hid nearby and watched. She would fly down near them and then back up again to the perch attached to the nest box. She repeated this several times. Finally one of the young followed her, and she pushed it in. One by one the others did likewise, and she went in after them and remained all night. The next evening the same performance took place, although she had more difficulty in getting them together. The third night she tried again, calling vigorously, but the brood were scattered and would not respond.—CHARLES S. PREBLE, Farmington State Teachers College, Farmington, Maine.

## REVIEWS

**Zoogeography.**—Edited by Carl L. Hubbs. 1958. (Published January 16, 1959.) Publication No. 51 of the American Association for the Advancement of Science. x + 509 pp. \$12.00 (\$10.50, prepaid to AAAS members).—Symposia on broad problems that cut across several disciplines have become one of the modern features of large scientific meetings in which diverse societies participate. In 1957 two such symposia in the field of zoogeography were held. The first was at Stanford University in August 1957 under the auspices of the Pacific Section of the Society of Systematic Zoology, as a feature of the joint meeting of the American Institute of Biological Sciences and the Pacific Division of the American Association for the Advancement of Science. It was cosponsored by the American Society of Ichthyologists and Herpetologists (Western Division), American Society of Zoologists, California Academy of Sciences, Pacific Coast Entomological Society, Society for the Study of Evolution, and Western Society of Naturalists. The variety of sponsoring societies is indicative of the interdisciplinary approach for the solution of problems in zoogeography. The symposium, entitled "The Origins and Affinities of the Land and Fresh-Water Fauna of Western North America," consisted of 14 papers, which were presented in two sessions, and was under the general chairmanship of Carl L. Hubbs. The second symposium, presided over by E. Raymond Hall, included six papers that were delivered at the meeting of the American Association for the Advancement of Science at Indianapolis on 28 December 1957. It was entitled "Geographic Distribution of Contemporary Organisms" and constituted Part I of a general symposium on "Some Unsolved Problems in Biology, 1957." This was a joint program of the AAAS, Sections F (Zoological Sciences) and G (Botanical Sciences), and was extensively cosponsored by the Society of Systematic Zoology, Ecological Society of America, Genetic Society of America, American Society of Naturalists, and Botanical Society of America. Fourteen of the papers from the first symposium comprise Part I of the book; three papers from the second symposium comprise Part II. In addition there is a final chapter, "General Conclusions," by Carl L. Hubbs.

In Part I, 10 papers deal specifically with the origins and affinities of parts of the fauna of western North America: Donald E. Savage, fossil land mammals; William H. Burt, recent land mammals; A. H. Miller, birds; Robert C. Stebbins, present amphibians and reptiles; Frank E. Peabody and Jay M. Savage, present amphibians and reptiles; Robert Rush Miller, fresh-water fishes; Robert W. Pennak, fresh-water invertebrates; Herbert H. Ross, northern and montane insects; James A. G. Rehn, dermaptera and orthoptera; E. Gorton Linsley, cerambycid beetles. Of these papers, Miller's is in the form of an editor's note and Stebbins' paper is an abstract. One additional paper by William Hovanitz deals with the distribution of butterflies, but it is concerned with the New World and not just western North America. A second group of three papers is concerned with the related data and problems from geology, paleontology, paleoclimatology, and physiology, which are an important part of the foundation needed to determine the origins and affinities of the fauna of western North America: Phillip B. King, evolution of modern surface features; H. D. MacGinitie, climates since the Cretaceous; George A. Bartholomew, physiology and distribution of terrestrial vertebrates. Part II, emphasizing some unsolved problems in the geographic distribution of contemporary organisms, comprises three papers:

Paul S. Martin, pleistocene ecology and biogeography of North America; Kenneth C. Parkes, palearctic element in the New World avifauna; W. Frank Blair, distributional patterns of vertebrates in the southern United States in relation to past and present environments.

The papers that are concerned with the distribution of specific parts of the fauna are rich in information and are presented for the most part in the best traditions of zoogeography. They contain the data that constitute the foundation of zoogeography and are a valuable addition to the literature because of the great competence of each of the authors in their specialized fields. Paradoxically, the strength of the volume is also in part its weakness, since, in the opinion of the reviewer, what is needed in zoogeography is more emphasis on the factors and processes involved in the development of patterns of distribution in contrast to mere descriptions of such patterns. This is not to belittle the value of descriptive biogeography. Sound taxonomy, extensive collections, and accurate descriptions of ranges are the foundation of biogeography. But what is not recognized often enough is that zoogeography must go beyond the mere accumulation of data. In order to derive explanations and to define the factors and processes involved and their interrelations the distributional data must be integrated with the data, concepts, and theories of many diverse fields. This is recognized in the present volume, and a good beginning is made in the group of three "background" papers that introduced the first symposium. King states fairly that there are wide gaps in the geological record, that much evidence is equivocal rather than decisive, and that there is much divergence among geologists as to what the evidence means. MacGinitie describes changes in climate since the Cretaceous, emphasizing changes in temperature, and relies heavily on past floras as indicators. He states strongly that the explanation of changing climates is not to be found in theories of wandering poles and drifting continents, but he does not evaluate the recent paleomagnetic and geologic data. In the reviewer's opinion, no amount of biologic or climatic evidence will be able to negate acceptable geophysical evidence of crustal displacement. The biologist and paleoclimatologist can only relate their interpretations to geophysical findings or theories. Bartholomew, in his sound and original analysis of the role of physiology in the distribution of terrestrial vertebrates, concludes that "... assignments of distributional limits on the basis of assumptions about the physiology of an animal are unrealistic." "Available knowledge of physiology helps to explain how a vertebrate can live where it does, but rarely reveals why it does not occur beyond the observed limits of its distribution. Physiological tolerances are permissive in that they set the environmental parameters within which a species can occur." On the basis of present knowledge "it appears to be more reasonable to look for the determinants of distribution of the higher vertebrates in behavioral and ecological factors, rather than in terms of physiological tolerances."

In view of the controversies and lack of fundamental knowledge in these related areas, it is obvious that the interpretations of origins and affinities that are given in the other papers must be evaluated in terms of the geologic, paleoclimatologic, and biologic knowledge that is used or implied. Despite the fact that the first symposium was concerned with origins and affinities of a fauna, there is no paper on the general problem of the methods for determining origins and affinities. Only two authors, D. E. Savage and W. H. Burt, discuss them, and it is obvious that the criteria they use are not valid for all groups or under all circumstances. As several authors emphasized, there is usually little or no basis for postulating

a region of origin and direction of dispersal with regard to the members of the Palearctic and Nearctic faunas.

In the final chapter, "General Conclusions," Hubbs superbly summarizes and evaluates the symposia. A succinct table provides an index to the subject matter under headings of geographical, background, and evolutionary and systematic considerations.

This volume is exceedingly valuable for its many excellent factual summaries of distributional data, for its diversity in groups of organisms considered, for its interdisciplinary and multidisciplinary approaches, for its demonstration of the need for a more dynamic approach to the problems of biogeography, and for its objectivity in considering some fundamental issues in zoogeography and evaluating our present state of knowledge. It could have been improved with more papers on the fundamental, theoretical questions of zoogeography and more papers on paleogeography, paleoclimatology, and paleoecology, with presentations of alternative points of view. It is the reviewer's hope that these papers will appear in future symposia.—ALBERT WOLFSON.

**Biologische Studien am Alpensegler.**—Hans Arn-Willi. 1960. Verlag Vogt-Schild AG, Solothurn, Switzerland. 204 pp., 54 photographs, 43 tables, charts and text figs. 19.60 Swiss francs.—Since the late forties, I have had a reasonably good idea of the magnitude and trends of Hans Arn's long-term researches on the Alpine swift (*Apus melba*) as they progressed, year after year; and, the longer the program continued, the more interesting and valuable it has become. Now, with a quarter century of original data behind it, Arn's monograph brings together the findings from his very intensive, accurate, and well-planned investigations of the biology of a highly specialized and distinctive form of life.

The book summarizes a vast amount of life history and behavior data, based upon field observations, laboratory examinations, marked nest sites, banding, etc. To me, the discussion of food habits was particularly informative, not only as illustrating the types of insects that the swifts take in their feeding flights but also in relation to the starvation that unfavorable weather can mean for a species dependent upon such sources of food. From June to the end of August in 1948, the year of the great "*Segler-sterben*," the weather was almost uninterruptedly rainy, with low temperatures; as a consequence of the unavailability of food, the young suffered nearly total mortality. Pronounced mortality associated with unfavorable weather was also recorded in 1953 and 1957.

The Alpine swift population of Arn's principal study colony, that for the Jesuit church in Solothurn, increased over most of the period of his study from 32 pairs in 1932 to 175 by 1955, thereafter (1956–1958) to drop somewhat. The most rapid rise took place between 1946 and 1954. Except for the wet and cold summers, the production of young in the colony followed rather closely in proportion to the numbers of nesting pairs. Substantial losses of young through predation, apparently largely due to cats and rats, were noted in 1937 and 1942—nothing comparable in severity to losses through the influence of weather on availability of food.

It is difficult to say what is most outstanding about a study as exhaustively carried on as this one has been, but certainly the banding results deserve special mention. From 1932 to 1956, 453 adult Alpine swifts and 4,561 nestlings were banded in Solothurn (though not all in the Jesuit church). Of these, 231 adults

and 597 young gave returns. Forty-eight birds banded elsewhere were also handled. From these results, data were obtained on fidelity to nest sites, longevity (average of 5.6 years, with two birds reaching 19 years, six reaching 18 years, four reaching 17 years, and one returning 17 years after having been banded as an adult), migration routes, and wintering quarters. Some banded birds were used in novel transportation experiments.—P. L. ERRINGTON.

**Wildlife of Mexico.**—A. Starker Leopold. 1959. University of California Press, Berkeley. 568 pp., 1 colored plate, 194 numbered figs. (including 1 colored map and numerous range maps, line drawings, and photographs). \$12.50.—One of the cardinal tenets of reviewing is supposed to be that an author should not be criticized for his objectives, and that his work should be judged entirely by his success in achieving those objectives. In this respect, the present book poses a curious problem. Its style is impeccable, its insights are deep, its judgments are scientifically sound, its format is superb, and its illustrations, executed by Charles Schwartz, are at once striking and profuse. Yet the work is impaired by a lack of central focus that verges on a serious shortcoming.

The major difficulty is spotlighted on the jacket, where in bold, black letters one-inch tall appears the title WILDLIFE OF MEXICO. Below in inconspicuous 3/16-inch white letters, pallid against a yellow background, is the qualification THE GAME BIRDS AND MAMMALS. A question immediately leaps to mind—what is properly game and what is not? A dictionary would answer that game is "wild birds, fish, or animals hunted for sport or for use as food." But the translation of this definition into operational terms is not the same in Mexico as it is in the United States. Below the border the mass of the people judge game in terms of the cost to procure. Only the larger, edible animals are considered worth the expenditure of a rifle bullet or a shotgun shell. On the other hand, a host of lesser creatures, songbirds that can be knocked down by slingshot and small mammals that can be snared, bulk large in the average Mexican's conception of fair game. Wood Rats (*Neotoma*) are even offered in the markets.

Against this background, Leopold's selection of game birds and mammals seems highly artificial—an exportation of our own conceptions to a foreign scene. Though he frankly acknowledged the difficulty, he does not effectively remove it. In dealing with birds he is highly selective; in dealing with mammals he adverts to the criterion of size alone and devotes discussion to everything as large as or larger than a cottontail with a special dispensation to include the squirrels and the weasel *Mustela frenata*. As a result his accounts include such dubious game as the Howler and Spider Monkeys, the Collared Anteater, the Nine-banded Armadillo, the Mexican Porcupine, and the Grison, but omit such economically important food producers as the various species of Wood Rats and Pocket Gophers. But despite these incongruities, the systematic sections of the book are a storehouse of valuable information, much of which is new.

Part I of the book, which is devoted to a general treatment of Mexico's wildlife resources and the management of these resources, is an important milestone in the conservation movement in North America. Here the author discusses, with a profound degree of discernment that could have come only from one of his experience and background, the land-use practices employed in Mexico and their sometimes devastating effects on the country's vegetation and its wildlife. He then delves into Mexico's existing program of wildlife conservation and

describes, without pulling his punches, the measures he believes are required to improve it and to insure the future of this resource. Most encouraging is the fact that this book was prepared with the blessings and the help of the leading game officials of Mexico, who are therefore surely cognizant of the problems of which Leopold speaks and of the difficulties with which they are faced. Under this informed wildlife administration the situation cannot escape general improvement, in which case Leopold's book will have served admirably the cause of conservation in that part of the continent where the need is most critical.—  
GEORGE H. LOWERY, JR.

**Birds of the West Indies.**—James Bond. 1961. Houghton Mifflin Company, Boston. 256 pp., 8 color plates, 186 line drawings. \$6.—The third of James Bond's West Indian bird guides carries the same title as the first (1936), but the approach is that of his *Field Guide to Birds of the West Indies* (1947) with minor changes. Geographical coverage has been extended to include the southwestern Caribbean islands of Old Providence and St. Andrew. Accounts of distribution have been brought up to date. The text is otherwise not greatly changed from the 1947 guide, but improvements in typography and in the arrangement of material make the information more readily accessible.

Of the 480 species admitted to the West Indian list, 430 are treated in the main text and the remainder retired to a "List of Vagrants." The typical account for species that breed in the West Indies gives "Local Names," "Description," "Voice," "Habitat," "Nidification," and "Range." Subspecies are not discussed as such, although geographical variations noticeable in the field often are mentioned under "Description." English and scientific names are indexed, but the index to local names, a useful feature of the earlier editions, is not included.

By some 80 changes in recommended English names Bond achieves a considerable advance toward a uniform English nomenclature for New World birds. As always, the advance is made at the expense of some appropriate and colorful names long in use. English names for species in common agree about 95 and 90 per cent, respectively, with those of *The Species of Middle American Birds* (Eisenmann, 1955) and the *Check-list of North American Birds* (1957).

With this edition the West Indian guide closely approaches standard North American guides in its wealth of illustration. About 75 per cent of the birds that breed in the West Indies and some of the commoner transients and winter residents are figured in line drawings by Earle Poole and eight new color plates by Don Eckelberry. The uniformly excellent plates (80 individuals of 66 species) are an important contribution to bird study in the West Indies. Additional plates for some groups still rather sparsely illustrated, such as the pigeons, quail-doves, and vireos, would be welcome.

Bond's guide remains indispensable to anyone with an interest in West Indian birds. One hopes that this attractive new edition will focus attention upon the critical need for protection of the region's many rare and threatened species.—  
WILLIAM B. ROBERTSON, JR.

**Mammalian Hibernation.**—Proceedings of the First International Symposium on Natural Mammalian Hibernation, 13–15 May, 1959. Edited by Charles P. Lyman and Albert Dawe. 1960. Bulletin of the Museum of Comparative Zoology at Harvard College, 124. 549 pp. Paper, \$3.00; cloth, \$4.50.—This important symposium, supported by the Office of Naval Research and sponsored by the



American Institute of Biological Sciences, brought together more than 40 active investigators of this interesting phenomenon. The 26 papers, the panel discussion, and the general discussions, as presented in this volume, will constitute for the more general reader a useful inventory of progress in this field since the last extensive general summaries by Lyman and Chatfield (*Physiol. Rev.*, 35: 403-425, 1955), Eisentraut (*Der Winterschlaf mit seinen ökologischen und physiologischen Begleiterscheinungen*. Jena, 1956), and Kayser (*Rev. Canad. Biol.*, 16: 303-389). Although it is true that this volume is of primary interest to mammalogists, mammalian physiologists, and comparative physiologists, it nevertheless has substantial interest for ornithologists. The so-called torpidity, accompanied by hypothermia, which occurs under certain conditions among some caprimulgids, micropodids, and trochilids, is certainly very similar to the hibernation of some mammals. Torpidity in birds is reviewed very well in this volume (pp. 93-103) by Oliver P. Pearson. Of further interest in this conjunction is the temporary nocturnal hypothermia that has now been observed in other species of birds. It is probable that further similarities will emerge, particularly between the processes of premigratory fat deposition in birds and prehibernation fat deposition in mammals. Possibly also important comparisons will emerge from studies of fat metabolism in migration and in hibernation, despite the great differences in metabolic rates. But the volume is to be recommended to ornithologists, and to biologists in general, primarily as a most interesting exposition of many of the facets of this striking adaptive phenomenon.—D. S. FARNER.

**Biological Clocks.**—*Cold Spring Harbor Symposia on Quantitative Biology*, Vol. XXV, xiii + 524 pp. 1960. Long Island Biological Association, Cold Spring Harbor, New York. \$8.—Biologists have long been aware of the prevalence of a plethora of functions with daily, annual, and other periodicities. However, it is only in the very recent decades that there has been intensive effort to characterize these functions accurately and, more importantly, to investigate the timing mechanisms involved. The almost explosive increases in investigations and investigators have been accompanied by an unusual number of differences in interpretation and generalization. Some of the differences have been semantic, but many are genuinely substantive, having their origins in the choice of experimental organisms, choice of experimental functions to be observed and measured, and the breadth of generalization employed in subsequent interpretations. It was thus extremely appropriate that the 1960 symposium concerned itself with "Biological Clocks." The participants included a substantial fraction of the current investigators of these interesting phenomena.

Much of the symposium was concerned with the so-called *circadian rhythms*, functions with periodicities of approximately 24 hours. It is this type of periodic function that has generated most of the controversy concerning the nature of biological clocks. The core of the controversy is centered on the question of the extent to which the biological clock is truly autonomous and intrinsic to the organism and the extent to which it simply represents a response to a periodic function in the environment. Roughly the positions of interpretation vary from the concept of genuinely internal periodic mechanisms that are relatively insensitive to temperature, and that can be entrained or phased by environmental periodicities such as cycles in light and temperature, to the concept that the biological clock is totally dependent on periodic functions in the environment. The former concept is analogous to an imperfect spring-operated clock that re-



quires frequent setting. The latter is analogous to the electric clock operated by a synchronous motor whose periodicity is wholly external in origin. These two positions are best presented by Colin S. Pittendrigh (pp. 159-182) and Frank A. Brown (pp. 57-70), respectively. Regardless of which analogy is acceptable, there is ample evidence that biological clocks operate at a cellular level as well as at whole-organism level. The symposium did not resolve the problem concerning the true nature of the biological clock. Possibly the perspective of time may ultimately show that it is naive to expect that resolution to a single type is possible. The wide occurrence of circadian rhythms suggests that they confer adaptive advantages and are not simple responses to environmental periodicities. If this is true, we must not exclude the possibility that the circadian rhythms, as we see them, may represent convergence by multiple solutions involving both types of clocks or even combinations thereof. There is an obvious need for investigations that will yield details of the mechanisms involved, but the reviewer is well aware of the difficulties involved.

It must be emphasized that biological clocks have functions other than that of controlling circadian rhythms. Astronomical orientation, for example, requires a chronometer. The contributions of Max Renner (pp. 361-367) on time sense and orientation in bees, Martin Lindauer (pp. 371-377) on sun orientation in bees, Klaus Hoffman (pp. 379-387) on the orientational clock in birds, Klaus Schmidt-Koenig (pp. 389-393) and Georg Birukow (pp. 403-412) on innate chronometry in insects, and Wolfgang Braemer (pp. 413-427) on the sun azimuth hypothesis all have an important bearing on this interesting subject. Of particular interest to ornithologists are the somewhat peripheral papers, "Does Celestial Navigation Exist in Animals," by Hans G. Wallraff, in which it is concluded that astronomic bicoordinate navigation has not been proved for any species, and "Star Navigation of Nocturnal Migrating Birds," by E. G. Franz Sauer and Eleonore M. Sauer, in which the hypothesis is reasserted. The attention given to annual and quasi-annual periodicities is disappointingly slight, especially in view of the many similarities in principle with the circadian rhythms and possible relationships between them. Indeed more attention to these annual and quasi-annual cycles might have been most useful in view of the indication of a rather broad spectrum of relationships between intrinsic timing mechanisms and mechanisms operating from environmental periodicities. Actually there are only three contributions that bear on this type of periodicity. The first is A. D. Lees (pp. 260-268), on "Some Aspects of Animal Photoperiodic Control of Annual Events." A. J. Marshall (pp. 499-505), in "Annual Periodicity in the Migration and Reproduction of Birds," discusses possible relationships between exogenous and endogenous control mechanisms in the control of reproduction and migration. Finally, Albert Wolfson (pp. 507-514), in "Regulation of Annual Periodicity in the Migration and Reproduction of Birds," presents new data and discussions bearing on photoperiodic mechanisms, reaffirms his assertion of photoperiodic mechanisms in equatorial species, discusses the differences between his interpretations and those of Marshall, and finally emphasizes quite correctly that as yet no endogenous annual periodicity has been demonstrated in any species of bird.

The symposium produced no novel ideas of importance. It did bring together many investigators whose data and hypotheses will have an important impact on the resolution of many of the problems associated with biological clocks. This volume is therefore of very great importance, and is highly recommended, as a

single inventory of much of the important current thinking about biological clocks.—D. S. FARNER.

**Im unbekannten Australien.**—Klaus Immelmann. 1960. Verlag Gottfried Helène, Pfungstadt/Darmstadt. 231 pp. DM 14.80.—Dr. Klaus Immelman, an able young German zoologist, was in Australia for a year (1959–1960) primarily to extend his interesting investigations on the behavior of the Zebra Finch, *Taeniopygia castanotis*. During the year his travels took him to all parts of the continent. In a delightful and nontechnical manner he has described many of his observations on Australian natural history in general, with emphasis on birds. Of particular interest is his description of the reproductive "cycle" of the Zebra Finch and its relation to climatic and weather conditions. But unquestionably the most interesting descriptions are those of the Kimberley country of north-western Australia and the almost unbelievable contrast between the dry and rainy seasons. A thoroughly enjoyable and informative book.—D. S. FARNER.

**A Field Guide to Western Birds. Field Marks of All Species Found in North America West of the 100th Meridian, with a Section on the Birds of the Hawaiian Islands.**—Roger Tory Peterson. 1961. Houghton Mifflin Company, Boston. 366 pp., 28 line illus. (some showing many species), 60 plates (36 in color). \$4.95.—This new, greatly revised, and enlarged edition of Peterson's "Western Guide" has been long awaited, and now proves well worth its wait (even in gold!). It is not only a much more complete treatment of western birds than the 1941 edition, but is more profusely illustrated (with the very essential page references by each species figured), treats ranges in much increased detail (including Alaska and western Canada), and adds valuable sections on habitat, nest, and eggs for each species. Almost 600 species, exclusive of Hawaiian birds, are treated in detail, and notes on 104 accidental or marginal species are added. The 1957 A.O.U. Check-list is followed for scientific and vernacular names, but older, well-established vernacular names are also given. All of the plates are new, and as fine as in other recent Peterson guides. Altogether, one feels that this is much more a new book than a new edition.

The most notable addition, and one that will be especially appreciated by an increasing number of observers, is the inclusion of a brief but excellent and well-illustrated treatment of Hawaiian birds. As slight criticism here (p. 331), perhaps the Puaiohi and Ooaa need not yet be considered as "near extinct," for John Bowles (who also should be given credit for observations on Kauai) and I found 12 or more individuals of each of these species. Such species might best be thought of as in danger of extinction if their restricted habitat is not preserved.

Another useful addition is a characterizing paragraph on each family and subfamily, and notes on the range, food, and number of species in the world and in the West for each family. Convenient check-lists on which to keep "life lists" are also added. The only feature present in the old edition, but lacking in the new, is an appendix on subspecies and their ranges. Perhaps, this feature, although valuable, will not be missed by many people.

Occasionally, field marks of species could have been added to or modified. The Omao (Hawaiian Thrush), for instance, has a markedly shorter and wider beak than the similar Puaiohi. Again, the females of the Red-winged and Tricolored blackbirds could be better characterized. Nevertheless, the vast majority of field marks seem very well chosen.

The colored plates have generally come out beautifully, although it might be commented, for example, that the Vermillion Flycatcher and Apapane are not red enough. Typographical or other errors seem so rare and minor as not to be worth mentioning. All in all, the book should long stand as a tribute to the skill and care of Peterson and the many individuals who have helped him.—FRANK RICHARDSON.

**Animal Sounds and Communication.**—W. E. Lanyon and W. N. Tavolga (Eds.). 1961. American Institute of Biological Sciences, Washington, D.C. 443 pp., 112 figs., 12-inch long-playing record. \$9.50.—The decision to publish in a more extended form the Symposium on Animal Sounds and Communication held at the 1958 AIBS meetings is abundantly justified in the present volume. Quite simply, there is no other source available in which the diversities of animal sounds, the problems of their measurement, and the varieties of interpretation are so clearly delineated. The resurgence of interest in the field of animal communication probably represents, more than anything else, the technological developments that permit high-quality field recording and playback and relatively rapid and valid graphical representations of these recordings. This book is in a sense a prolegomenon to further research using the new devices.

Emlen's brief introductory chapter is followed by discussions by Kellogg of recording techniques and equipment, and by Borror on the analysis of sounds, particularly with the sound spectrograph. Both are essentially nontechnical and should prove of value to the neophyte.

The remainder of the book is devoted to sound communication in various taxonomic groups. Alexander's discussion of communication in *Orthoptera* and *Cicadidae* is the clearest, most comprehensive, and concise presentation the reviewer has seen. Bogert's chapter on sonic communication in amphibians and reptiles is also excellent, though not so concise. The chapters on underwater communication in fish (Tavolga), the ontogeny of bird vocalization (Lanyon) and its utility for mate selection (Marler), and the attempt to classify animal sounds (Collias) leave the reader, paradoxically, somewhat dissatisfied because they are so well done. In short, they clearly present the defects in the current approaches to animal communication. It would appear that the principal need now is for more adequate dependent variables.

In Lanyon's work, for example, early isolation or controlled contact with other species has an obvious effect on the primary song. The effect is described as variation in motif, but measures of similarity or differences along some dimensions that will define a motif are lacking. The seriousness of this should not be underestimated. Experimental tests of environmental or physiological influences on vocalization are not very convincing without some index of variability. Thus, the hypothesis that song imitation is a function of the number of exposures to the "tutor's" song cannot be tested unless certain quantifiable song dimensions are identified, and the within-group and between-group variances on these dimensions are assessed.

Marler clearly recognizes the problem of variability among songs but is not very explicit regarding the dimensions of variation. His chapter, entitled "Bird Songs and Mate Selection," is devoted almost exclusively to the demonstration that individual voices and dialects are identifiable by the human ear and by sound spectrograph. They are conceivably identifiable by birds as well, in which

case they may function in mate selection. The evidence is correctly described as circumstantial.

Collias has been more concerned than has Marler with behavior as a dependent variable, and he attempts to classify animal sounds with specific reference to the eliciting situation and the response of the communicant. It is clear, however, that identification of the essential information in, say, the "food-finding call" or the "all clear signal" will require more precise definition and quantification of the response to the calls.

Hockett in the concluding chapter presents 13 "design-features" of language by which communication of different species may be compared and evaluated. This is a competent summary and a well-written and highly provocative attempt at integration. It is somewhat puzzling that neither Hockett nor any of the other contributors considered their data from the standpoint of information theory. It would seem that channel capacity, storage load, uncertainty, equivocation, sequential dependencies, etc. could be highly useful concepts, and information theory itself could provide a conceptual framework for systematic analysis of animal communication.

The long-playing record is a valuable supplement, especially when one is able to compare the sound to the sound spectrographs. Ease of using the record in this manner varies considerably, however, with the Borror and Marler bands, clearly keyed to the text, representing a near ideal. Neither Bogert nor Lanyon keys the record to the book at all, the former presenting the calls in a different order than they appear in the book while the latter includes some calls that are not depicted at all. Commentaries on the various bands range from straight identification on most bands to the descriptive comment on the Collias band, which sounds as if written for high school students. A brief introduction to each of the bands would have been helpful.

Technically, the quality of the record is uneven and illustrates some of the difficulties of field recording. Extraneous sounds from wind, from other organisms, or from the recorder itself mar some of the recordings, as do low S/N ratio, print-through, and variations in sound level. The record was meant to be edifying rather than esthetic, however, and these shortcomings do not seriously affect the usefulness of the record.

The publication of book and record provides a much needed summary of the experimentation on animal communication, and an exceedingly rich source of hypotheses for further work. On the basis of the delineation of problems alone, the book would be a valuable one. Including as it does information from a diversity of organisms, and sampling the ingenuity and mentation of the most active investigators in the field, the book is a must for the serious student of animal communication.—F. D. KLOPPER.

**Sounds of Nature.**—Vol. 1. Songs of Spring. Vol. 2. A Day in Algonquin Park. Vol. 3. Birds of the Forest. Vol. 4. Warblers. Vol. 5. A Day at Flores Morales. Vol. 6. Finches. Recorded by D. J. Borror and W. W. Gunn. Six 12-inch 33 rpm records. Federation of Ontario Naturalists, Edwards Gardens, Don Mills, Ontario, Canada. \$5.95 each.—Now that the last of these records of bird song has been published, it may be appropriate to review the series as a whole. The task is complicated by the varied aims that the producers have set for themselves. Two of the records (Vols. 4 and 6), in which Dr. Borror was a major participant, are serious attempts to portray representative songs of two

families of birds, the finches and the wood warblers. Two (Vols. 2 and 5) are "atmosphere" records, seeking to convey a sound picture, mainly through bird voices and some other sounds as well, of quite different areas, the Canadian forest, and the South American Llanos. The remaining two (Vols. 1 and 3) are designed primarily for instruction and to some extent for pleasure. This diversity of treatment is no accident. As the handout states, "since people vary in their tastes and needs, the Federation too, has varied its approach in the design and content of the records." The experiment has been remarkably successful. The volumes on warblers and finches provide remarkably complete coverage. Songs of several individuals are included in almost every case, together with a note of the approximate locality and date. There are often several songs from each individual. The songs are ordered according to pattern rather than by taxonomic criteria, which increases their usefulness as an aid in field identification. These unique records will be invaluable to every scientifically minded ornithologist, and indeed to anyone concerned with the analysis of animal vocalizations. *Songs of Spring*, and *Birds of the Forest* are likewise well designed for their appropriate audience, the intelligent layman. Fewer birds are represented, 25 and 22 species, respectively, only half as many as on the finch and warbler records. In one there is an extended spoken narrative. In the *Songs of Spring*, each species is represented twice, once identified directly, and the second time unnamed in a group sharing the same habitat, an ideal device for the instruction of school children and students. The Federation can also provide matching color slides for this purpose. Finally the recordings from Algonquin Park and Flores Morales are mainly esthetic in intent, and succeed admirably. They are guaranteed to evoke nostalgia in anyone familiar with the areas concerned, although relatively few North Americans will know the bird species in the Flores Morales volume. So perfect is the recording, here as in the entire series, that one almost wishes to hear some extraneous natural noise, but this is a minor point. We may hope that the success of this series will encourage the Federation to produce another of the same high standard.—P. MARLER.

**Sounds of Midway: Calls of Albatrosses of Midway** (J.B.-2808-D 1). Recorded by Hubert, Mabel and Carl Frings and H. Franklin Little of the Pennsylvania State University, 1958. A 12-inch 33 $\frac{1}{3}$  rpm microgroove record pressed on one side only, time 19 min.—This entire disc is devoted to the vocalizations of two species, the Laysan Albatross (*Diomedea immutabilis*) and the Black-footed Albatross (*Diomedea nigripes*). The vocalizations of the Albatrosses are presented under approximately 16 headings with voice commentary accompanying and explaining each type of vocalization. Emphasis is placed on the behavioral aspects of the sounds, and in some instances meaning is ascribed to the vocalizations. For each type of sound, generous samples are presented for both the Laysan and Black-footed birds. Some of the sounds described are: general colony sounds, incidental beak sounds, nest beak sounds, defensive beak sounds, rolling beak sounds, whistling calls for territory identification, nest calls when preparing to settle on eggs, challenge calls, sky calls, victory calls, fighting sounds, distress calls, and dancing sounds. Derivation of dancing sounds is proposed, and there is a brief discussion of Albatross language at the end.

This record is, in my opinion, a distinct scientific contribution in that it presents the sounds as only a record can, along with careful explanation and observational details. I predict that it will be followed as a model for the

presentation of the vocalizations of a species. Technically the recording is excellent. In only a few of the songs is wind or other objectionable noise noticeable.—P. P. KELLOGG.

# RECENT LITERATURE

EDITED BY FRANK MCKINNEY

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- Boyd, E. M. 1958. Birds and some human diseases. Bird Banding, **29**: 34-38. —A discussion of a number of diseases and the role of birds in their transmission.—R. E. P.
- Carriker, M. A., Jr. 1959. New species of Mallophaga (*Alcedoffula* and *Philopterus*) from Colombia and the United States. Neotropical Miscellany 12. Novedades Colombianas, **1**: (4): 205-213.—Mallophaga of four American kingfishers and of a South American dipper, *Cinclus leucocephalus*.—E. E.
- Flint, V. E., A. Zemskaya, and V. E. Sidorov. 1959. [The role of ecological groupings of birds in the feeding of the tick *Ixodes persulcatus*.] Zool. Zhurn., **38**: 476-480.—In the Maritime Provinces of the U.S.S.R. infestation by ticks affected 80 per cent of bird species of river bottomland but only 30 per cent of taiga species. Tick density coincides with bird population density. (In Russian; English summary.)—E. E.
- Harrison, J. G. 1958. Tuberculosis in wildfowl; tuberculosis from a Wigeon and a Shelduck from Britain. The Wildfowl Trust 9th Annual Report: 70-71.
- Hyshka, W. B. 1960. Combating an outbreak of botulism at Old Wives Lake (1959). Blue Jay, **18**: 24-25.
- Jennings, A. R. 1959. Causes of death of birds at Slimbridge, 1955-1957. The Wildfowl Trust 10th Annual Report: 37-40.—The results of postmortem examinations on 680 waterfowl.—F. M.
- Lapage, G. 1958. Parasites of the Anatidae. The Wildfowl Trust 9th Annual Report: 66-68.—Includes a provisional list of the more dangerous genera of parasites which have been recorded in the family.—F. M.
- Rasheed, S. 1960. The nematode parasites of the birds of Hyderabad (India). Biologia, **6**: 1-116.
- Soulsby, E. J. L. 1958. Visceral parasites in wildfowl. The Wildfowl Trust 9th Annual Report: 68-69.

## DISTRIBUTION AND ANNOTATED LISTS

- Barcells, R. E. 1960. Fauna ornitológica barcelonesa. I) *Curruca rabilarga* (*Sylvia undata*, Bodd.) en landas del macizo del Tibidabo. II) Aves nidificadoras en jardín suburbano del Prat de Llobregat. III) Aves del jardín de la universidad. Misc. Zool. (Mus. Zool. Barcelona) **1** (3): 122-173.—Data on birds of Barcelona, Spain. The first section deals with the biology of *Sylvia undata*; the second with the breeding birds of a suburban garden; the third with the birds found in the garden of the University of Barcelona in the middle of the city. (In Spanish; summaries in English and German.)—E. E.
- Bartlett, C. O. 1960. American Widgeon and Pintail in the Maritime Provinces. Canad. Field-Nat., **74**: 153-155.—Breeding records and summary of status.
- Ellis, D. V. and J. Evans. 1960. Comments on the distribution and migration of birds in Foxe Basin, Northwest Territories. Canad. Field-Nat., **74**: 59-70.
- Frade, F. and A. Bacelar. 1957. Catálogo das aves da Guiné Portuguesa. I. Non Passeres. Anais Junta de Investigações do Ultramar, 1955, **10**, t. 4, fasc. 2: 1-194. Estudos de Zoologia.—This catalog of the birds of Portuguese Guinea lists all nonpasserines (195 species), giving technical name, synonymy, Portuguese name, localities, measurements, color of soft parts, and general

- distribution. The list is preceded by an ornithological history of the area, a gazetteer, and a bibliography.—E. E.
- [Kunkle, D. *et al.*] 1959. First supplement to the Annotated List of New Jersey Birds. 13 pp. Urner Ornith. Club, Newark Mus., Newark, N. J.—A carefully prepared report on 96 species in which there have been changes in status or nomenclature or significant new developments since the 1955 booklet by David Fables. The committee that prepared this list adopted the sound view that subspecies identification must be supported by a specimen and thus be subject to verification by later workers, and that sight reports of species new to the state must be based on observations of more than one observer and accompanied by details. This report gives useful data on the northward range extension of several southern species, and on the increasing frequency of western wanderers to the Atlantic coast.—E. E.
- Manville, R. H. 1960. Birds breeding at Cap des Rosiers, Quebec. *Wilson Bull.*, **72**: 406–407.
- Mills, E. L. 1960. Bird observations in the Queen Charlotte Islands, British Columbia. *Canad. Field-Nat.*, **74**: 156–158.
- Mueller, H. C. and D. D. Berger. 1959. The Swainson's Hawk in Wisconsin. *Passenger Pigeon*, **21**: 142–144.—Wisconsin records and field identification.
- Olivares, A. 1959. Aves migratorias en Colombia. *Rev. Acad. Colomb. Cien. Exact. Ris. Nat.*, **10** (41): 1–72.—Description and status of 188 bird forms believed to be migratory or casual in Colombia; the overwhelming majority are North American. It should be noted that the Eared Grebe, here listed as migrant *Colymbus caspicus californicus*, has recently been described as a new resident form. (In Spanish; English summary.)—E. E.
- Olivares, A. 1960. Algunas aves de Gaitania (Municipio de Atace, Tolima, Colombia). *Caldasia*, **8** (38): 369–382.—Report on a collection made in the Upper Magdalena valley of Colombia. (In Spanish; English summary.)—E. E.
- Oordt, G. J. van. 1959. Summer records on pelagic birds in the North Atlantic, 1948 and 1958. *Ardea*, **47**: 41–48.—An account of three trans-Atlantic voyages, making comparisons with reports of other observers.—E. E.
- Southern, W. E. 1960. The birds of Hunt Hill Sanctuary. *Passenger Pigeon*, **22**: 3–10.—Check-list for the Audubon Camp of Wisconsin.
- Traylor, M. A. 1960. Notes on the birds of Angola, non-passeres. *Publ. Cult. Co. Diam. Angola, Lisboa*, **51**: 129–186.—Taxonomic and distributional notes on 80 species of Angola birds, including additions to the avifauna. These notes are preparatory to a prospective check-list.—E. E.
- Urban, E. K. 1959. Birds from Coahuila, Mexico. *Univ. Kansas Publ. Mus. Nat. Hist.*, **11**: (8) 443–516.—A check-list of the 312 forms (249 species) known. The basis for the records is given, with details in the cases of the 500 specimens in the University of Kansas museum.—E. E.
- Weeden, R. B. 1960. The birds of Chilkat Pass, British Columbia. *Canad. Field-Nat.*, **74**: 119–129.

#### ECOLOGY AND POPULATION

- Anemars, A. 1959. On the determination of the size and composition of a passerine bird population during the breeding season. A methodological study. *Vår Fågelvärld, Suppl.* **2**: 1–114. Price, 9 Sw. kr.—An account of the errors made in the various methods used for determining bird populations with sugges-

- tions for improving accuracy. There is a good deal of mathematical and statistical discussion and a good bibliography of bird censusing methods.—E. E. Brooks, W. S. 1960. Songbird communities of two marsh habitats. *Passenger Pigeon*, **22**: 111–125.
- Crowell, K. 1961. The effects of reduced competition in birds. *Proc. Nat. Acad. Sci.*, **47**: 240–243.—Comparison of method of feeding, feeding height, and nesting habitat of populations of the Cardinal, Catbird, and White-eyed Vireo resident in Bermuda with those of eastern North America indicates that "absence of competition in Bermuda has allowed the few species present to attain far greater densities" than on the mainland.
- Graber, R. S. and J. S. Golden. 1960. Hawks and owls: population trends from Illinois Christmas counts. *Ill. Nat. Hist. Surv. Div. Biol. Notes*, **41**: 1–24.—Analysis of data in the Audubon Christmas counts for Illinois from 1903–1955 indicates a marked general decline of wintering raptors, with the exception of the Bald Eagle, which has been noted more frequently since the 1940's.—E. E.
- Höglund, N. H. 1955. [Body temperature, activity and reproduction of the Capercaillie] Viltrevy, **1**: 1–87.—An experimental study on hatchery-raised chicks. Homeothermy sets in at the age of 18 days when adult temperatures are reached and body weight has increased four times. Diurnal rhythmicity of body temperature is also shown. During the first fortnight, chicks must be brooded to maintain their body temperature. Adverse weather is critical at this stage because it reduces feeding time between broodings. Wet weather also had an effect because of inadequate waterproofing of the down. These findings are correlated with varying climatic conditions and the local success of populations in different parts of Sweden. For example, high maximum June temperature coincides with marked increase of the Capercaillie stock in central Sweden. Locally continental climate provides the bird with surer reproductive success than do the locally maritime regions; it is also significant that the northern populations have longer feeding days. (Swedish with copious English and German summaries.)—M. D. F. U.
- Larson, S. 1960. On the influence of the Arctic Fox, *Alopex lagopus*, on the distribution of Arctic birds. *Oikos* **11** (2): 276–305.—The absence of certain arctic birds, and the scarcity of others, on low-arctic areas of Greenland and on low-arctic Spitsbergen, induced this study of distributional ecology. The predatory role of arctic fox, skua, and raven is discussed and compared with adaptations in choice of nesting habitat, presence or absence on certain parts of their circumpolar arctic range, and with antipredator behavior traits of arctic anatids, larids, and limicoles. These factors all point toward the main thesis of the author, i.e., that where lemming is absent, the fox and other predators live on the tundra birds and these are controlled, or even limited in their distribution, by the predators. The above-outlined evidence is not of the nature that a student of population dynamics would accept as full documentation of facts; nevertheless these well-founded correlations warn us against overgeneralization of the importance of the food factor for population existence and abundance.—M. D. F. U.
- Marcström, V. 1960. Studies on the physiological and ecological background to the reproduction of the Capercaillie (*Tetrao urogallus*, Lin.). Viltrevy, **2**: 1–85.—The yolk sac is an important food depot at hatching, and during the first 24 hours of life its content increases the dry weight of the chick by more than 10 per cent. This material gained from the yolk is used by the chick for

syntheses rather than for catabolism of the body. After  $2\frac{1}{2}$  days the protein, carbohydrates, and lipid content of the remainder of the yolk sac is different in fed and in starved chicks. The liver has no mobilizable food substances at hatching, but it gains in dry weight due to protein and carbohydrate increase even in starved chicks. Subcutaneous fat depots of the hatching chick are rapidly used up when starved. In starving chicks, such as under unfavorable weather conditions, the fat depots are used up after the yolk sac is depleted, and thus thermal insulation of the body is decreased. Thus the first day of life seems to be the least critical from the point of view of weather; on the other hand the detrimental effect of rain and cold lasts longer than the first week of their life. Egg production, fertility and hatchability of eggs, and the condition of the chick did not vary during the two seasons considered, although these years were different from the point of view of population fluctuations. It is concluded that meteorological conditions during reproduction are of fundamental importance to the reproductive capacity, and through it to the population fluctuations of the Swedish Capercaillie. (In English, with Swedish summary.)—M. D. F. U.

- Nero, R. W. 1960. Mass mortality of Western Grebes. *Blue Jay*, **18**: 110-112.
- Provost, M. W. 1959. Impounding salt marshes for mosquito control and its effects on bird life. *Florida Nat.*, **32**: 163-170.—In Florida the use of impoundments to flood salt marshes during the egg-laying season of mosquitos and sand flies to prevent their propagation, without injuring fisheries, is greatly increasing the bird life of the intertidal area.—E. E.
- Sladen, W. J. L. 1960. The flora of a breeding area of Pink-footed Geese in central Iceland. *Proc. Linnean Soc. London*, 171 sess., 1958-59, pt. 1: 30-52.—Botanical communities of the largest breeding colony of *Anser brachyrhynchus* are analyzed.—E. E.
- Tinbergen, L. 1960. The dynamics of insect and bird populations in pine woods. *Archiv. Néerland. Zool.*, **13** (3): 259-472.—This memorial volume to the late L. Tinbergen includes articles by Tinbergen and his collaborators or students, de Ruiter, H. Klomp, N. Prop, J. H. Mook, L. J. Mook, H. S. Heikens, and P. Glas on population dynamics, particularly the effect of bird predation and parasites on the control of insects, the role of "searching images" on the hunting of titmice, and the effect of population density on habitat selection.—E. E.
- Wynne-Edwards, V. C., D. Jenkins, and A. Watson. 1960. A population study of Red Grouse in Scotland. *New Scientist*, **8**: 709-711.—*Lagopus scoticus* may control their own population by expelling some of their number when food resources are limited.—E. E.
- Young, H. 1958. Some repeat data on the Cardinal. *Bird Banding*, **29**: 219-223.—Data from 225 catches of 88 Cardinals are used to evaluate accuracy of recapture data for estimation of population parameters. Evidence is presented to show trap-shy and "trap-happy" and how they may bias samples.—R. E. P.

#### GENERAL BIOLOGY

- Anderson, H. G. 1959. Food habits of migratory ducks in Illinois. III. *Nat. Hist. Surv. Bull.*, **27**, art. 4: 289-344.—Study of 17 species based on gizzard contents.—E. E.
- Balen, J. H. van. 1959. [On the reproduction of the Black-tailed Godwit, *Limosa limosa* L.] *Ardea*, **47**: 76-86.—The taking of 30 first clutches resulted

- in 12 second clutches within the area, and on removal of these in 3 third clutches. Intervals between egg-taking and first egg of new clutch were 5-16 (av. 7.2) days. When eggs were taken in a late stage of incubation, birds usually left the area. A table summarizes comparable data for many species. (In Dutch; English summary.)—E. E.
- Blurton Jones, N. G. and R. Gillmore. 1959. Some observations on wild geese in Spitsbergen. The Wildfowl Trust 10th Annual Report: 118-132.—Information of distribution, hatching and fledging dates, breeding success, nest sites, brooding and care of goslings, and molt in Pink-footed Geese.—F. M.
- Dennis, J. V. 1958. Some aspects of the breeding ecology of the Yellow-breasted Chat (*Icteria virens*). Bird Banding, **29**: 169-183.—A study of the habitat occupied and life history information that might have a bearing on fall occurrence of the Chat north of its breeding range. Includes weights, characters for sexing, sex ratios.—R. E. P.
- Getz, L. L. 1961. Hunting areas of the Long-eared Owl. Wilson Bull., **73**: 79-82.—*Asio otus* hunted in open, grassy areas, catching primarily *Microtus pennsylvanicus*.—J. T. T.
- Höglund, N. H. 1956. [On sex-distinguishing characters in Capercaillie chicks.] Viltrevy, **1**: 150-157.—Color of the beak, of the growing secondaries, and other feather markings aid aging of the chicks during the first four weeks of their life. (Swedish, with English and German summaries.)—M. D. F. U.
- Keith, L. B. 1960. Observations on Snowy Owls at Delta, Manitoba. Canad. Field-Nat., **74**: 106-112.—Includes measurement data on 13 juveniles, bursal regression rate, daily movements in winter.—R. W. N.
- Koskimies, J. 1956. [Age determination of gallinaceous birds by the 'outer primary' method.] Viltrevy, **1**: 158-161.—The outer primary is not molted during the first fall molt of the juvenile bird: color and shape characters are useful in aging. (Swedish, with English and German summary.)—M. D. F. U.
- Larimer, E. J. 1960. Winter foods of the Bobwhite in southern Illinois. Ill. Nat. Hist. Surv. Div. Biol. Notes, **42**: 1-35.—Analysis of crops from 4,606 birds taken during the hunting seasons of 1950 and 1951.—E. E.
- Laskey, A. R. 1958. Blue Jays at Nashville, Tennessee. Movements, nesting, age. Bird Banding, **29**: 211-218.—Information from banding 1,000 jays. Some behavior and life history observations.—R. E. P.
- Lehmann, V. F. C. 1959. Contribuciones al estudio de la fauna de Colombia XIV. Nuevas observaciones sobre *Oroaëtus isidori* (Des Murs). Novedades Colombianas, **1** (4): 169-195.—Behavior and nesting of a little-known South American eagle; well illustrated.—E. E.
- Meanley, B. 1961. Late-summer food of Red-winged Blackbirds in a fresh tidal-river marsh. Wilson Bull., **73**: 36-40.—In the Chesapeake Bay region large numbers of *Agelaius phoeniceus* fed in the wild rice beds, primarily on the seeds of this and two other aquatic plants. The attractiveness of these foods apparently reduced damage by blackbirds to nearby corn.—J. T. T.
- Skutch, A. F. 1961. Life history of the White-crested Coquette Hummingbird. Wilson Bull., **73**: 5-10.—*Paphosia adorabilis* nests in southern Costa Rica from December through February. Courtship, nest and eggs, incubation and feeding of young (both solely by the female) are described. A colored plate by D. R. Eckelberry accompanies the article.—J. T. T.
- Terrill, L. M. 1961. Cowbird hosts in southern Quebec. Canad. Field-Nat., **75**: 2-11.



- Timmerman, A. and M. F. Morzer Bruijns. 1959. [The breeding season of the Lapwing, *Vanellus vanellus* in 1957.] *Ardea*, **47**: 87-98.—Comparison is made between egg laying in areas where collection of eggs for food is permitted for the first part of the breeding season and areas of complete protection in the Netherlands. (In Dutch; English summary.)—E. E.
- Warham, J. 1958. The nesting of the Pink-eared Duck. The Wildfowl Trust 9th Annual Report: 118-127.—Observations on *Malacorhynchus membranaceus* made in Western Australia. Breeding grounds, nest, incubation and hatching behavior, characteristics and calls of the ducklings, and feeding habits are described.—F. M.
- Weller, M. W. 1961. Breeding biology of the Least Bittern. *Wilson Bull.*, **73**: 11-35.—The nesting habitat of *Ixobrychus exilis* was studied in several marshes in Iowa. Nesting activities and behavior are described in detail and illustrated with photographs. Experiments were performed on the releasing stimulus for feeding in young.—J. T. T.
- Wilhelm, E. J., Jr. 1960. Marsh Hawk breeding in northwestern Arkansas. *Wilson Bull.*, **72**: 401-402.—Incubation period and pellet analysis at one nest.
- Woodford, J. and F. T. Lovesy. 1958. Weights and measurements of wood warblers at Pelee Island. *Bird Banding*, **29**: 109-110.

#### MANAGEMENT AND CONSERVATION

- Borg, K. 1955. [The use of chloralose for capture of corvids and other birds.] *Viltrevy*, **1**: 88-121.—An experimental study of the effects, lethal dose, and availability of the narcotic chloralose with respect to bird control. It is an excellent and humane means of controlling crows, gulls, feral pigeons, etc. with little risk of secondary poisoning. (Swedish, with English and German summaries.)—M. D. F. U.
- Boyd, H. 1958. Wildfowling in the U.S.A. and Britain. The Wildfowl Trust 9th Annual Report: 137-142.—Although a detailed survey has not yet been undertaken, wildfowlers probably comprise a much smaller proportion of the population in Britain and they travel less than American hunters.—F. M.
- Griffin, D. N. 1959. The poisoning of meadowlarks with insecticides. *Wilson Bull.*, **71**: 193.—Seven *Sturnella magna* and *S. neglecta* were killed by eating oat and barley seeds that had been treated with insecticides.—J. T. T.
- Holm, E. R. and R. V. Bauer. 1959. Potentialities of certain species of waterfowl for mass production. *N. Y. Fish and Game Journ.*, **6**: 1-45.—Deals chiefly with Pintail, Gadwall, Redhead, and Canvasback.—E. E.
- Jahn, L. R. 1961. The status of waterfowl conservation. A contribution from the Wilson Ornithological Society Conservation Committee. *Wilson Bull.*, **73**: 96-106.—A review of recent developments in the management of waterfowl habitat and populations. "The major immediate needs to conserve waterfowl are known. Prairie pothole type breeding habitat must be preserved, especially on the Canadian prairie. Crop depredations must be controlled. Hunting mortality must continue to be regulated in relation to the status of populations, particularly for individual species and manageable flocks." The need for prompt action, especially in the preservation of pothole breeding habitat, is stressed. While the extinction of species is not imminent, waterfowl populations must be maintained at a reasonable level to meet increasing public demands.—F. M.
- Marshall, D. B. 1958. The Pacific Flyway. The Wildfowl Trust 9th Annual



- Report: 128-137.—A popular account of the waterfowl of the western states, the refuge system, and management techniques.—F. M.
- Matthews, G. V. T. 1958. Feeding grounds for waterfowl. *The Wildfowl Trust 9th Annual Report*: 51-57.—Proposes encouraging landowners to practice rotational winter flooding of grasslands to provide feeding areas near wildfowl reserves in Britain.—F. M.
- Matthews, G. V. T. 1958. Wildfowl conservation in the Netherlands. *The Wildfowl Trust 9th Annual Report*: 142-153.—An interesting discussion of the status of waterfowl management with special emphasis on the problems of reclamation, drainage, hunting, and duck decoys.—F. M.
- Matthews, G. V. T. 1959. Wildfowl conservation in Denmark. *The Wildfowl Trust 10th Annual Report*: 71-77.—Shooting pressure is higher in Denmark than in the Netherlands, but, in the absence of duck decoys, the total wildfowl taken is of the same order. All license income is devoted to conservation interests. Recent research and management programs are described.—F. M.
- Stephen, W. J. D. 1960. The use of exploders in protecting crops against Sandhill Crane depredations. *Blue Jay*, **18**: 23-24.
- Teplov, V. F. and N. N. Kartashev. 1958. Wildfowl research in Russia. *The Wildfowl Trust 9th Annual Report*: 157-169.—A translation of a paper published in Russian in the (Moscow) *Zoological Journal*, **35** (1): 77-88 (1956), providing information on waterfowl distribution, migrations, and hunting in the Ryazan district in the European part of the U.S.S.R. Data on spring shooting, the use of decoys, and the banding program are given. The authors' suggestions for waterfowl management procedures are particularly interesting.—F. M.

#### MIGRATION AND ORIENTATION

- Abramson, I. J. 1960. Migration on the Dry Tortugas. *Florida Nat.*, **33**: 139-144.—Birds on Garden Key, Florida, increased enormously in species and numbers when a cold front passed over during the night of 7-8 May 1960.—E. E.
- Anweiler, G. 1960. The Boreal Owl influx. *Blue Jay*, **18**: 61-63.
- Baird, J., C. S. Robbins, A. M. Bagg, and J. V. Dennis. 1958. "Operation recovery"—the Atlantic coastal netting project. *Bird Banding*, **29**: 137-168.—Description of operation and results from cooperative netting at 22 stations along the Atlantic coast during Aug.-Sept. 1957. Discusses returns and effects of weather on migration.—R. E. P.
- Bellrose, F. C. 1958. Celestial orientation by wild Mallards. *Bird Banding*, **29**: 75-90.—Wild-trapped Mallards showed a strong tendency to fly north on clear days or nights when released after variable holding periods from release sites 11 to 33 miles from the Illinois River valley. Orientation was random on overcast days or nights, and was independent of the season or of the presence or absence of the moon.—R. E. P.
- Blake, C. H. 1958. Leg sizes and band sizes; third report. *Bird Banding*, **29**: 90-98.
- Boyd, H. 1959. Greylag Geese in Britain in winter. *The Wildfowl Trust 10th Annual Report*: 43-58.—Counts in the field suggest that in late November 1957 and 1958 the population numbered between 17,000 and 23,000. Analysis of banding recoveries shows that wintering geese bred in Iceland. The small Scottish breeding population is nearly sedentary. Distribution of flocks throughout the winter and local movements are documented.—F. M.

- Boyd, H. 1959. Movements of marked Sea and Diving Ducks in Europe. The Wildfowl Trust 10th Annual Report: 59-70.—Analysis of banding recoveries for Pochard, Scaup, Common Scoter, Velvet Scoter, Long-tailed Duck, Goldeneye, Red-breasted Merganser, and Goosander.—F. M.
- Coffey, L. C. 1958. Weights of some Chimney Swifts at Memphis. Bird Banding, **29**: 98-104.—Seasonal variations indicate rapid build-up of weight just before fall departure. Study based on weights of 1,839 swifts. Information is given on weight loss during time necessary for weighing and banding large numbers.—R. E. P.
- Donker, J. K. 1959. Migration and distribution of the Wigeon, *Anas penelope* L., in Europe, based on ringing results. Ardea, **47**: 1-28.—Most Wigeon wintering in western Europe derive from U.S.S.R. Iceland-bred birds winter chiefly in the British Isles, but of 70 recoveries six were from the Atlantic coast of North America. Some Iceland-bred birds were later recovered in U.S.S.R. during the breeding season, apparently having accompanied U.S.S.R. Wigeon after pairing on winter quarters.—E. E.
- Hamilton, W. J., III and M. C. Hammond. 1960. Oriented overland spring migration of pinioned Canada Geese. Wilson Bull., **72**: 385-391.—Adult, pinioned *Branta canadensis*, released or escaping from captivity in spring, walked and occasionally swam from two to 25 miles northward toward their breeding grounds.—J. T. T.
- Hickey, M. B. 1960. Migrants at airport ceilometers. Passenger Pigeon, **22**: 23-26.—Account of mortalities in Wisconsin in 1952 and 1959.—R. W. N.
- Höglund, N. H. 1956. [Swedish Sportsmen's Association's marking of game 1945-1954.] Viltrevy, **1**: 162-224.—A marking method has been worked out whereby downy young of gallinaceous birds and waterfowl can be tagged on the patagium with a safety pin bearing an aluminum plate 1 sq. cm. in size. This allows marking at the time they are easiest to catch and when the tarsus could not bear an adult-sized band. Over 21,000 birds of many species have been tagged or banded during the period here accounted for, and 960 recoveries are reported in the paper. (Swedish, with English summary.)—M. D. F. U.
- Höglund, N. H. 1957. [Swedish Sportsmen's Association's marking of game 1955-1956.] Viltrevy, **1**: 283-317.—Data on marking recoveries (especially long-range recoveries of birds) out of about 4,500 marked birds and mammals. (Swedish, with English summary.)—M. D. F. U.
- Höglund, N. H. 1960. [Swedish Sportsmen's Association's marking of game 1957-1958.] Viltrevy, **1**: 352-397.—Over 7,500 birds marked each year, 75 per cent upland game birds. Nearly 900 recoveries are reported here; wing marks proved to be very useful, those recovered after 5-10½ years had no sign of corrosion. (Swedish, with English summary.)—M. D. F. U.
- Kemper, C. A. 1959. More TV tower destruction. Passenger Pigeon, **21**: 135-142.—A review of past records in this area, an account of mortalities in 1959 (1,200 on one occasion), and a new theory for their occurrence.—R. W. N.
- Middleton, R. J. 1958. Banding Catbirds at Norristown. Bird Banding, **29**: 229-232.
- Moltoni, E. 1959. [Incursion in Italy of the Bohemian Waxwing—*Bombycilla g. garrulus* (L.)—in 1959.] Riv. Ital. Orn., **29**: 170-172.—In Europe, as in America, there was a waxwing incursion during the winter of 1958-59. (In Italian.)—E. E.
- Odum, E. P. 1958. The fat deposition picture in the White-throated Sparrow in

- comparison with that in long-range migrants. *Bird Banding*, **29**: 105-108.—Weight data from birds killed at a TV tower in Florida support the idea that birds of passage are fatter than birds destined to stop in the area. Compares White-throats with warblers and vireos.—R. E. P.
- Parmalee, P. W. and B. G. Parmalee. 1959. Mortality of birds at a television tower in central Illinois. *Audubon Bull.*, **111**: 1-4.—On 16-17 September 1958 an estimated 1,000-1,500 birds were killed; 827 specimens of 40 species were examined; *Hylocichla ustulata* and *H. minima* accounted for over 30 per cent.—E. E.
- Proescholdt, B. 1961. Weather and early spring migration in Iowa. *Wilson Bull.*, **73**: 41-45.—In March 1959 the northward movement of many migrants was associated with a warm wind from the south. A day or two later a cold front crossed the area, and moderate numbers of blackbirds were observed moving southward.—J. T. T.
- Russell, J. C. 1960. Eastern Kingbird in numbers during migration. *Florida Nat.*, **33**: 225.—In Lake Alfred section of Florida "at least a thousand" seen on 26 August about 500 at one time.—E. E.
- Shaub, B. M. 1958. A juvenal Evening Grosbeak appears in Northampton, Massachusetts in late October 1957. *Bird Banding*, **29**: 31-34.
- Sladen, W. J. L. and W. L. N. Tickell. 1958. Antarctic bird-banding by the Falkland Islands Dependencies Survey, 1945-1957. *Bird Banding*, **29**: 1-26.—Report on the banding activities of the FIDS, including information on bands, techniques, distribution, ages, mating permanence, and homing of antarctic birds.—R. E. P.
- Turček, F. J. 1958. On bird banding in the U.S.S.R. *Bird Banding*, **29**: 111-112.—Gives numbers of birds banded by families and some of the numbers banded at different stations, as well as band types.—R. E. P.
- Walkinshaw, L. H. 1960. Migration of the Sandhill Crane east of the Mississippi River. *Wilson Bull.*, **72**: 358-384.—From the summarized migration records of *Grus canadensis* it is apparent that cranes migrate on a relatively direct route between the Lake Michigan area and southeastern Georgia, most of them making this distance in one flight.—J. T. T.
- Wolfson, A. 1960. Experimenting with bird migration. *Northwestern Tri-Quarterly*, Fall, 1960: 23-30.—A lucid popular account of experiments on the role of light and darkness in stimulating spring migration. The dark periods seem most important in producing the essential preparatory (refractory) phase; the light periods seem effective in the progressive phase, which results in the physiological condition that precedes migration.—E. E.

## PHYSIOLOGY

- Blake, C. H. 1958. Respiration rates. *Bird Banding*, **29**: 38-40.
- Fabricius, E. 1959. What makes plumage waterproof? The Wildfowl Trust 10th Annual Report: 105-113.—Experiments involving the removal of the oil gland from Tufted Ducks showed that the secretion from the gland is not essential for waterproofing. Contact with smearing substances (*e.g.*, raw fish) causes plumage to lose its waterproofing. Madsen's view that waterproofing is achieved by finely distributed air in the feathers is confirmed.—F. M.
- Höhn, E. O. 1960. Seasonal changes in the Mallard's penis and their hormonal control. *Proc. Zool. Soc. London*, **154**: 547-555.

- Marcström, V. 1956. [Body temperature of Capercaillie chicks during and after hatching.] Viltrevy, **1**: 139-149.—Relatively high (mean of 45 records: 39.5°C) hatching temperature is believed due to high muscular activity; during drying of the down evaporative cooling has been shown. (Swedish, with English and German summaries.)—M. D. F. U.
- Wilson, P. N. and D. F. Osbourn. 1960. Compensatory growth after undernutrition in mammals and birds. Biol. Rev., **35**: 324-363.—Review of the literature indicating that after being kept with an inadequate diet, animals usually gain quickly their normal weight, or may even overcompensate, when a normal food supply is afforded.—E. E.

## TAXONOMY AND PALAEONTOLOGY

- Amadon, D. 1959. Behavior and classification. Vierteljahrsschr. Naturforsch. Ges. Zürich, **104**: 73-78. In Festschr. H. Steiner.—Even when a behavior pattern involves learning, it may be useful to systematists if under normal conditions it develops with reasonable consistency.—E. E.
- Johansen, H. 1957. [Subspecies and populations of the Capercaillie, *Tetrao urogallus*.] Viltrevy, **1**: 233-266.—A study based mainly on the color variation of around 350 skins from the whole distribution area of the species. The ranges of the subspecies are mapped, and also groups recognizable on account of minor color differences are described; a postglacial distributional account is attempted. (German with Swedish summary.)—M. D. F. U.
- Mainardi, D. 1960. Immunological relationships and taxonomic position of the Linnet, a cardueline bird. Atti, V Riunione Sci. dell'A.G.I.: 3-8.—Though Vaurie places the Linnet, as *Acanthis cannabina*, in a genus separate from the Goldfinch, *Carduelis carduelis*, the Siskin, *C. spinus*, and the Greenfinch, *C. chloris*, immunological studies indicate that the Linnet is more closely related to these birds (particularly to the Siskin) than they are to each other.—E. E.
- Matthews, G. V. T. 1959. Techniques in wildfowl taxonomy. The Wildfowl Trust 10th Annual Report: 31-36.—A brief review of recently developed techniques.—F. M.
- Miller, L. 1960. Some Indian midden birds from the Puget Sound area. Wilson Bull., **72**: 392-397.—The bird species represented by bones in two midden collections from the Pacific Northwest are compared.—J. T. T.
- Verheyen, R. 1959. Note sur la systematique de base des Lariformes. Inst. Roy. Sci. Nat. Belgique Bull., **35** (9): 1-16.—Though near relatives of the shorebirds (Charadrii), the gull group is considered entitled to ordinal rank. On anatomical grounds two suborders are recognized, Rynchopi for the skimmers and Lari for the rest. The family and subfamily treatment is like that of Peters, except that *Gygis* is given subfamily rank, equal to the Sterninae, and—more surprising—the noddies are removed from the terns and made a subfamily (Anoinae) of the Stercorariidae.—E. E.
- Verheyen, R. 1959. Contribution à l'anatomie et à la systematique de base des Ciconiiformes (Parker 1868). Inst. Roy. Sci. Nat. Belgique Bull., **35** (24): 1-34.—Though allied, the flamingos are placed in their own order, for their inclusion would render it impossible to define the Ciconiiformes. On anatomical grounds, Ciconiiformes are divided into four suborders, Ardeae (*Cochlearius* being given only tribal status in Ardeidae), Scopii, Balaenicipites, and Ciconiae (Ciconiidae and Plegadidae).—E. E.

- Verheyen, R. 1960. Outline of procedure in basic avian systematics. *Gerfaut*, **50**: 223-230.—The writer says "there are no two species with exactly the same skeleton and pterylosis," though accurate description of the differences may be difficult. Urges that even though selection of characters is subjective, if all characters known are weighed equally, a more objective classification will result where a large number of characters are involved.—E. E.
- Verheyen, R. 1960. Les nandous (Rheiformes) sont apparentés aux tinamous (Tinamidae/Galliformes). *Gerfaut*, **50**: 289-293.—Points out characters in which the rheas resemble the tinamous and concludes that they are more closely allied than are the rheas to the ostriches. (English summary).—E. E.
- Verheyen, R. 1960. Les Kiwis (Apterygiformes) dans les systèmes de classification. *Bull. Soc. Roy. Zool. d'Anvers*, **15**: 1-11.—The Kiwis have skeletal characters suggesting distant relation to the penguins. *Apteryx owenii* Gould is held generically distinct from *A. australis* and a new genus *Kiwi* is erected for it; *Stictapteryx Iredale* and Mathews 1926 is considered a *nomen nudum*. (English summary).—E. E.
- Verheyen, R. 1960. Les tinamous dans les systèmes ornithologiques. *Inst. Roy. Sci. Nat. Belgique Bull.*, **36** (1): 1-11.—Verheyen concludes that the tinamous should be treated as a suborder of the Galliformes, and that the resemblances are not the result of convergence. Unfortunately, as with other papers of this series, Verheyen lists characters of the tinamous, but gives no indication which are shared with the Galliformes and which by the Rheiformes; he merely states baldly that 76 per cent of the listed characters are shared with Galliformes and that they are closest to the *Cracidae* and the *Odontophorini*.—E. E.
- Verheyen, R. 1960. Les Pelecianiformes et le paille-en-queue (*Phaethon*). *Inst. Roy. Sci. Nat. Belgique Bull.*, **36** (25): 1-18.—A case is made for removing the tropicbirds, Phaethontidae, from the order Pelecianiformes, on the basis of differences from all the other included groups in anatomical, morphological, and behavioral characters. Verheyen places *Phaethon* in a separate order, Phaethoniformes, allied to the Lariformes and Procellariiformes. The Pelecianiformes are divided into four suborders and five families.—E. E.
- Voous, K. H. 1959. Individual and geographical variation in the Songthrush, *Turdus philomelos* Brehm. *Ardea*, **47**: 28-41.

#### MISCELLANEOUS

- Coulter, M. W. 1958. A new waterfowl nest trap. *Bird Banding*, **29**: 236-241.—Describes a hoop net that is staked around the nest and "sprung" by pulling it up around the incubating bird by a string leading to a suitable observation point.—R. E. P.
- Hoffmann, L. et al. 1960. Station biologique de la Tour du Valat. Cinquième compte rendu d'activité et recueil des travaux. 1958.—This report of the activities of the biological station in the Camargue, southern France, includes complete reprints of 17 Camargue papers by various authors published between 1958-1960 in a variety of journals, plus accounts of bird banding results during 1958. Eight of the papers deal with ornithology; among these two by J. J. Swift on the reason for crowded nesting by flamingos and on the biology and ethology of the European Bee-eater have especially wide interest. Articles by L. Hoffmann on the control of lead poisoning and by U. Glutz von Blotzheim on sex and age recognition and body weights of the European Coot will inter-

est waterfowl students. (In French or German; some papers with English summaries.)—E. E.

Labisky, R. F. 1959. Night-lighting: a technique for capturing birds and mammals. *Biol. Notes*, **40**: 1–11. Ill. Nat. Hist. Survey Div.

Scott, P. and H. Boyd (Eds.) 1958. The Ninth Annual Report of The Wildfowl Trust, 1956–1957. Country Life, London. 10/.—In addition to papers on anatomy, breeding biology, diseases and parasites, and various aspects of conservation and management (see separate abstracts) this report includes information on a variety of waterfowl topics: a census of Barnacle Geese in western Scotland; food and feeding habits of wildfowl; observations on waterfowl made by Peter Scott in Australia, New Zealand, and New Guinea (including such little-known species as *Anas waiguensis*, *Hymenolaimus malacorhynchos* and *Anas chlorotis*); the effect of weather on the distribution of Pink-footed Geese in Europe; the proportion of first-winter birds in flocks of Brent Geese in Essex; and an account of an expedition to northeast Greenland.—F. M.

Scott, P. and H. Boyd (Eds.) 1959. The Tenth Annual Report of The Wildfowl Trust, 1957–1958. 10/.—Papers on behavior, migration, conservation, general biology, and physiology are abstracted separately. This report also contains contributions on many aspects of the Trust's work—wildfowl counts, aerial surveys, establishing Canada Geese, research on Brent Geese. Visits to Iceland, Ungava Bay, the Canadian prairies, and European zoos are described. A list of British literature on European wildfowl covering the years 1945–1957 is a useful addition.—F. M.

### NOTES AND NEWS

The American Ornithologists' Union will meet in 1961 at Washington, D.C., with The United States National Museum and the Bureau of Sport Fisheries and Wildlife, U.S. Fish and Wildlife Service, as host organizations, and the Audubon Naturalist Society of the Central Atlantic States as sponsoring organization. The scientific sessions will be held Tuesday, Wednesday, and Thursday, 17-19 October, in the auditorium of the U.S. National Museum. The business sessions will be held on Monday, 16 October, at places to be announced later. A field trip is planned for Friday, 20 October. The Annual Banquet will be held in the ballroom of the Hotel Willard on Thursday evening, 19 October.

Applications for a position on the program should be submitted not later than 1 September. A formal "call for papers" will be circulated well before the deadline.

Convention headquarters will be the Hotel Willard, Pennsylvania Avenue and Fourteenth Street, N.W., Washington 4, D.C., situated in the heart of down-town Washington and within walking distance of the National Museum.

This will be the fourteenth Washington meeting and the first since 1938.

The Thirteenth International Ornithological Congress will convene at Cornell University, Ithaca, New York, from June 17 to 24 1962.

The official announcement and application for membership in the Congress are now ready for distribution. Interested persons who have not already done so should send their names and addresses to the Secretary General *as soon as possible*.

A small fund has been obtained to provide partial support for the travel of a few persons coming from outside North America. Application forms will be sent to persons requesting them. (Citizens of the United States and Canada are not eligible.)

All applications for membership, travel grants, and places on the program should be returned to the Secretary General *before December 1, 1961*.—Charles G. Sibley, Secretary General, Fernow Hall, Cornell University, Ithaca, New York, U.S.A.

The attention of the editor has been drawn recently to the appearance of a new periodical, the *Bio-Acoustics Bulletin*, the first number of which appeared in March. It is to be published quarterly by the Laboratory of Ornithology, Cornell University, Ithaca, New York, under the editorship of William R. Fish. The editorial board consists of Peter Paul Kellogg, W. W. H. Gunn, and Peter Marler. Manuscripts and other communications should be sent to the editor at 4532 Mill Race Road, Sacramento 25, California. Requests for copies, which are available at 50 cents each, should be sent to the Laboratory of Ornithology. According to the editor the purpose of the *Bulletin* is "... to provide a means for the exchange of information that may be helpful and newsworthy to those who are interested in good recording techniques and results and in the advancement of bio-acoustics research." The first number, consisting of six pages, also contains a brief article by Peter Paul Kellogg, "Problems of Storing Natural Sounds on Tape."

The editor has just been advised of the death of Mr. Frederick V. Hebard on 29 March. Mr. Hebard became a member of the Union in 1930 and an elective member in 1951.



Ernst Mayr, a former president of the Union, and Alexander Agassiz Professor of Zoology, Museum of Comparative Zoology, Harvard University, has been appointed director of the Museum, effective 1 July 1961.

The staff of the Percy Fitzpatrick Institute of African Ornithology has been strengthened by the appointment on 1 March of Mrs. M. K. Rowan, and on 1 June of Mr. C. J. Skead, former Director of the Kaffrarian Museum, as Research Officers. Mrs. Rowan is investigating the relationships among the species of Colies in the South Western Cape. Mr. Skead will work on life histories of the birds of the Eastern Cape and on the ecology of forest birds in the same area.

The University of Georgia announces the awarding of the 1961 Stoddard-Sutton prize to Mr. Herbert W. Kale for his work on the breeding populations of Long-billed Marsh Wrens in Georgia salt marshes. The prize consists of a cash award accruing from the interest on the income received from the sale of the book *Georgia's Birds* by T. H. Burleigh. The award honors Herbert L. Stoddard, eminent Georgia ornithologist and conservationist, and George M. Sutton, who prepared the illustrations for the Georgia volume. The purpose of the award is to encourage a student (undergraduate or graduate) at the university who shows promise in original investigations in ornithology or wildlife ecology. Mr. Kale's work with the marsh wrens has also received national recognition in the form of a Frank M. Chapman award granted to aid his continuing work.

The Karl P. Schmidt Fund has modest sums available to assist persons wishing to study at the Chicago Natural History Museum. Grants will be made for study in any of the four fields encompassed by the museum: anthropology (with a natural history orientation), botany, geology (including paleontology), and zoology. An applicant should describe the study proposed in brief terms, state the length of time he wishes to study at the museum and the amount of money needed, and name one reference.

Applications should be mailed to: Chairman, The Karl P. Schmidt Fund, c/o Chicago Natural History Museum, Roosevelt Road and Lake Shore Drive, Chicago 5, Illinois.

#### OBITUARY

Charles E. W. Bryant, Corresponding Fellow of the A.O.U., died on 27 October 1960, after a prolonged illness. A native of Victoria (born at North Fitzroy on 12 June 1902), he was for many years the leading ornithologist of that state. In Whittell's bibliography of Australian ornithology 102 papers, mostly short notes, of his are listed for the period 1928-1950. His best papers deal with the life history and ecology of marsh birds; he was also a very successful bird photographer. In private life he was a busy attorney.

Bryant's greatest contribution to ornithology consisted in his devoted service as editor of the *Emu* for 31 years, during which he always maintained the highest editorial standards. American ornithologists who visited Victoria enjoyed his hospitality and benefited from his eagerness to show them the Victorian birds he knew so well. He became a Corresponding Fellow of A.O.U. in 1949 and a Corresponding Member of the B.O.U. in 1950. He was the recipient of an Australian Natural History Medallion in 1957 and served as president of the R.A.O.U. in 1955-1957. A detailed memorial will be published in the *Emu*.—  
ERNST MAYR.

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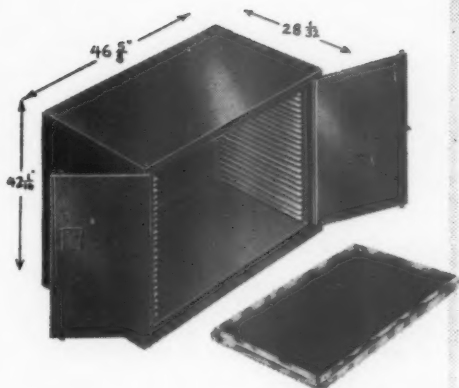
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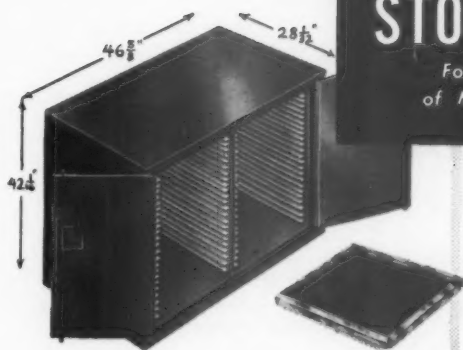
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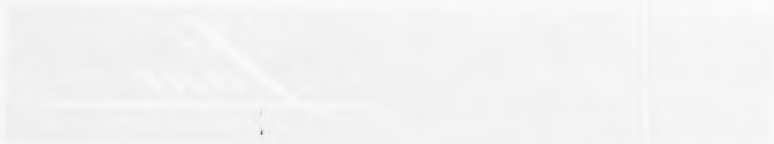
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